THE TELEGRAPHIC JOURNAL AND

# Electrical Review.

VOL. XXI.—No. 516.

## A NEED OF THE AGE.

SEVEN months ago the semi-annual convention of the National Electric Light Association of America inspired us with the idea that it would be a wise thing and a good one for the electrical engineers of the United Kingdom to form themselves into an association which should meet periodically and formally discuss subjects of practical and immediate interest to the profession. In our issue of March 18th of the present year we threw out the idea accompanied by an exhortation, to germinate and move in the minds of our readers. There were obstacles and difficulties in the path, and obvious arguments for the fuller utilisation of existing media rather than the multiplication of societies or associations. We were inclined to think the difficulties slight and the arguments answerable; what was—and is—needed was—and is—a spirit of energy in a sufficient number of men to attack the situation boldly and carry out a definite but broad plan of action. We believe the idea has germinated, for we have frequently heard favourable allusion to it, and now, upon the recurrence of the American Association's convention, it has once more burst out in print. Our esteemed contemporary the *Electrician* has this time been moved by the spirit of emulation and progress, and has gone even a little further than we ventured to go half a year back—has reproduced the idea, and given it rather more defined shape and a little additional clothing.

Since our first mention of the matter it has often occupied our thoughts, and we have attentively listened to expressions of opinion upon cognate subjects. The suggestion that use should be made of existing associations to a greater extent than hitherto was one which compelled attention, and if it can be demonstrated to be practicable to an appreciable extent, we must admit that it will be the most sensible plan to adopt. The recent meeting of the British Association has produced some discussion—perhaps not in a direct sense, but indirectly—as to its availability for the purposes of the electrical engineer, and in the last number of *Industries* appeared an excellent critical letter by Mr. W. B. Esson upon this subject. The conclusion to which Mr. Esson has come, a conclusion which will be shared, we think, by the majority of our readers—by all of them who are practical men,—is that the British Association meetings, as at present arranged, are *not* suited to the requirements of the electrical fraternity. It is true that on particular days there is a preponderance of papers upon electrical subjects in Sections A and G, but it is an unvarying rule that more papers shall be upon the programme than there is time to read and adequately discuss, the result being that some are not read at all, and some only in the briefest of abstracted forms, while very few are discussed as fully and completely as they deserve to be. Hurry and haste of the description with which those who attend British Association meetings are familiar do not favour the calm and clear discussion so essentially necessary for a proper interchange of ideas upon new branches of industry. Mr. Esson proposes that the defects of this system shall be remedied, so far as regards electrical matters, by the formation of a sub-section in connection with the section devoted to mechanical science, wherein electrical subjects only shall be dealt with. If this plan be carried out in a manner sufficiently opposite to that in which much of the sectional business is conducted to permit of the effective treatment of electrical engineering problems, we give our unhesitating adhesion to it; and at any rate we think it is amply worth while to make the effort to procure the additional section or sub-section. This would of course meet one of the great wants to which we have drawn attention, and we are not without hopes of seeing the plan accomplished.

There will still remain, however, the need of a permanently active association which shall be thoroughly representative of the whole electrical profession. It may seem like rank heresy to say that the Society of Telegraph-Engineers and Electricians does not come under this denomination; but to those who, without undue zeal on the one side or prejudice on the other, apply impartial minds to the matter, it must be evident that it is inclined to lag behind rather than to lead. Pursuing the idea of utilising existent machinery, we may suggest that it is possible to effect something of a revolution in the ways and habits of the Society. Reorganisation to meet the needs of the times, the infusion of a little vitality in the procedure, and a little more whole-hearted support from the growing body of men engaged in electrical pursuits, may yet make of what was orginally simply a club of telegraph men something of which the whole electrical profession may be proud. Here, too, the effort is worth making. To attempt to rival the Institution of Civil Engineers at this early day would be nothing short of folly; but we may, without displaying an inordinate degree of vanity, emulate it in some respects and to some extent. At present it is rather a melancholy reflection that by far the greatest encouragement to practical research and the publication of results comes from a body which, though not exactly an outside one, is yet not specifically electrical. The fostering care of the one peculiarly electrical association is confined to the receipt of fees, the provision of a library (which candour compels us to say is undoubtedly a good one and a boon to those for whom it is provided), and the convening of a few meetings in the winter time. Surely there is scope for a little vigour and a little enterprise. Let an effort be made to galvanise this lethargic corporation into life and activity. With the essential elements which are already at command—an excellent library and a secretary who is zealous, untiring and uniformly courteous—the task should not be a hopeless one. If the effort fails of effect, then let the dull body be, and start afresh with younger blood and higher aims.

TWO serious accidents, one of them resulting fatally, from the use of the alternating current recently occurred in New Orleans in the course of five weeks. Our readers will remember that about a year ago a fatal accident which was thought to have been caused by the alternating current from the Grosvenor Gallery central station, aroused some attention here in London. There was an element of uncertainty in this case, inasmuch as the victim fell from a great height with a force which was in itself quite sufficient to explain the fatal result. There can be no doubt, however, that with this comparatively new system there are dangers to be guarded against which are not common to other methods of electric lighting, and therefore it is imperative that more than ordinary care should be taken to prevent ill results from inadvertent contact with the wires. Proper insulation of the leads is one very obvious remedy; and another, which perhaps has less force here than in America, is to run the alternating circuits separately and out of reach of men working on other wires. The use of transformers has met with a very slight application in this country so far, but it may perhaps in the future receive as great a development as any other method of electric lighting, and it would be nothing more than the wisest economy to observe extreme precautions at the outset. Even where there is absolute innocence, to give a dog a bad name is to create a strong prejudice against the poor creature; but if it really be a snappish, uncertain kind of brute, the tale of its ill-deeds will travel all the faster and all the further.

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AN illustration of the extreme safety of the electric light is afforded by the decision of the Austrian authorities to adopt it for the illumination of the Government powder mill at Stein. Ordinary artificial illuminants are, from the nature of the case, precluded here, and hitherto, with the passing away of the light of the sun, the mill has been closed. Demand for powder is growing in Austria, however, and the output has to be increased in some manner. The plan which commended itself as the most economical, was to run the mill night and day. The main objection to night work was the necessity for artificial light; but after due enquiries and investigation the Government came to the conclusion that, with the adoption of suitable precautions, the electric light might be made absolutely safe.

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IF any doubts had existed in the public mind as to the practicability of electricity for tramcar propulsion it must have been dissipated by the demonstration which took place on Wednesday, further particulars of which may be found in our other columns. We were highly gratified to find that the favourable comments we have so often made upon Mr. Elieson's system were most emphatically endorsed by authorities no less eminent than Profs. Silvanus Thompson and John Perry. Mr. Elieson very sensibly remarked that no enterprise can be indefinitely carried on without encouragment and support of a pecuniary kind, and we hope that the success which has attended the ten weeks' daily operations of the Elieson Company's electric locomotives will not be rendered abortive. Up to the present time no attempt has been made to induce the public to support the scheme, but we honestly think that the directors, if they thought fit, might now appeal for public subscriptions with every chance of success, for they control a really *bonâ fide* investment; but probably the fusion of rival schemes would still more commend itself. The experiments with the electrically propelled boat, although carried out with absolute success, we look upon as a sort of pleasant diversion in the proceedings of the day, but they probably had the effect of giving a still greater belief to the public that the ends which may be served by the employment of electrical energy are practically boundless.

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A FINE opportunity is to be given the exponents of electric traction in America on the 19th of this month, for on that day a street railroads' convention is to be held in Philadelphia. All the leading street roads in the United States will be represented, and efforts are being made to bring the subject of electric cars prominently before the convention. The arrival of Mr. Reckenzaun in the States gave quite a fillip to the principle of electric locomotion there, and the matter has received much greater attention as the result of the demonstration which has been given by him in conjunction with Mr. Wm. Wharton in the streets of Philadelphia, than had ever before been accorded it by existing tramway, or more properly speaking, street railway corporations. It is said that after the closing of the convention electric motors will be put into regular use on all the street railroads of Philadelphia.

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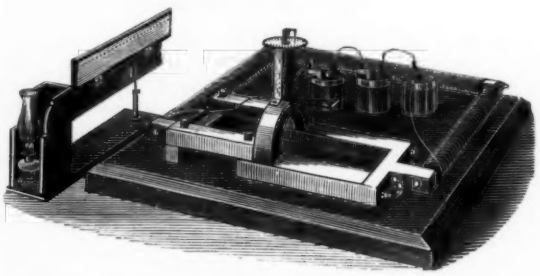
MADAME ROZE-MAPLESON--Marie Roze of the opera stage—has raised her voice against the carelessness which prevails in many theatres in the employment of gas on the stage. "Why not," says she, "in addition to providing additional exits, endeavour to reduce the chances of fire to a *minimum* by exercising greater care on the stage, where the real danger lies?" We incline to the opinion that the chances of fire can really be reduced to a *minimum* only by the total abolition of gas from the stage; but we join with the fair songstress in insisting that greater care shall be taken so long as gas is retained. "On the stage," continues Madame Mapleson, "gas jets are found in every direction, in the closest proximity to the scenery and other inflammable material, and gas battens entirely unprotected are frequently used when scenes have to be set in a hurry. In fact, gas is found everywhere on and about the stage, and is often laid on for temporary use by means of rubber tubing. If such a state of things existed in our private dwelling houses, we should be afraid to sleep in them. How timid we feel at the slightest escape of gas, and immediately summon the gasfitter. Yet, on the stage of a theatre one's olfactory nerves are invariably poisoned with the escape of gas, to which no one appears to pay the slighest attention, as it is supposed to be a necessary evil." Negligence, imprudence, or inattention, on the part of *employés* in theatres, resulting fatally, is visited with fines and imprisonment in France, ranging from 50 to 600 francs and from three months to two years, and under the law not only the *employés* engaged on the stage, but also the director of the Opera Comique at Paris, recently destroyed, are awaiting trial at the Paris Assizes. Some similar law in this country would probably lead to a much closer observance of the requirements of safety by English operatic and theatrical managers. The disaster at Exeter has been a terrible warning, and has resulted in many much-needed improvements before and behind the curtain, but there is not the slightest doubt that very much remains to be done in many places.

## ON A MAGNETIC BRIDGE OR BALANCE FOR MEASURING MAGNETIC CONDUCTIVITY.*

By THOMAS A. EDISON.

PERHAPS no electric measuring instrument has proved more useful in practice, especially if we consider the various forms which it has assumed, than the device contrived by Christie and commonly known as Wheatstone's bridge. It was with a belief that a similar instrument could be constructed which should perform the same service for magnetic measurements that the experiments were made, the results of which I have the honour now to present to the section.

The Wheatstone bridge is based upon the fact that if two points of different electric potentials are united by two conducting paths the fall of potential along these paths is absolutely the same provided that these paths are absolutely alike electrically. Consequently if two points equidistant from the place of higher potential be connected together no current will flow through the connecting wire. So by analogy, if two points be maintained at a constant difference of magnetic potential the fall of potential from one to the other through two or more paths will be absolutely uniform in all, provided these paths be magnetically identical. Hence, at any two points equidistant from a given terminal, the magnetic potential is the same, and these points could be without differential action upon a magnetic pole.



EDISON'S BRIDGE FOR MEASURING MAGNETIC CONDUCTIVITY.

The magnetic bridge may be constructed in the form of a rhomb, the typical form of the Wheatstone bridge. For this purpose the four sides are made of the purest Norway iron, as soft as possible and thoroughly annealed. To the acute angles of the rhomb are connected the poles of a long U-shaped electro-magnet, whose function is to develop the desired magnetic potential difference at these points. Connected to the two obtuse angles and projecting inward are two bars of Norway iron, similar in section to those forming the sides. Their inner ends, which are hollowed out, approach to within about a half inch of each other, Between these ends a stirrup is suspended by means of a silk fibre, which stirrup carries a short needle consisting of a thin tube of hardened steel well magnetised. To the stirrup is attached either a pointer moving over a graduated arc, or better, a mirror by means of which the deflection can be read in the usual way with a lampstand and scale.

In the instrument now in use in my laboratory (see accompanying illustration) the magnetic bridge is in the form of a rectangle, the ends or poles of the electro-magnet being connected to the middle of the short sides, while the bars which pass inward to the needle are joined to the middle of the longer sides. The four halves of these longer sides constitute the sides of the bridge. The two at one end of the rectangle are fixed, the two at the other end are movable. The two bars which pass inward to the needle are curved so as to form a semicircle standing above the plane of the rectangle. The needle itself is similar in construction to that above described, but is suspended by a wire attached to a torsion head.

It will be readily seen that when the electro-magnet is charged, a constant difference of magnetic potential is maintained at the two ends of the rectangle, so that if the four bars constituting the sides of the bridge are magnetically identical, there will be no difference of magnetic potential between the ends of the bars which pass to the needle, and hence there will be no deflection. But if one of the movable bars be loosened, the needle is at once deflected, and in a direction depending upon the side the bar occupies. If the bar is entirely removed the deflection is a maximum of course. And if it be replaced by another bar differing in cross section, in quality of iron, or in any other way which affects the magnetic conductivity through the bridge, the deflection shows at once the amount of difference between that bar and the original one taken as a standard. The instrument is extraordinarily delicate, and the principal difficulties encountered in using it have arisen in the attempt to preserve this delicacy, while, at the same time, the range of the apparatus is maintained.

The magnetic bridge was devised for the purpose of testing readily the quality of the iron purchased for the construction of dynamos. Very great variations are observed in irons supposed, commercially, to be of the same quality. Consequently the potential difference developed by a dynamo having field cores of such iron can never be exactly calculated. But by comparing the iron which is to be thus used in the magnetic bridge, its exact value for dynamo purposes may be determined, and the constants of the generator thus accurately calculated in advance.

But this bridge, it would seem, will be equally useful for testing iron and steel for other purposes. By its means not only may the character and quality of the metal be ascertained in terms of any desired standard, but flaws in the interior of a bar, such as a car axle, may be discovered at once.

Constructed with sufficient care and attention to details, the magnetic bridge may without doubt be made a most valuable instrument of precision for the furtherance of scientific research. The theory of its action is extremely simple, and it is the exact counterpart of an ordinary Wheatstone bridge constructed for measuring low resistances, since now whatever is true electrically of the one is true magnetically of the other. Not only may the laws of magnetic conductivity be investigated by means of this balance for all paramagnetic and diamagnetic bodies, but the variation of this conductivity under the action of various physical agencies, such as heat, pressure, strain, &c., may be determined. It is in the belief that this instrument may contribute something to the advancement of electrical science, and with the hope that it may do so, that I venture to bring it to the notice of my fellow members of the American Association.

* Read before the American Association for the Advancement of Science, New York, August, 1887.

## NOTE ON SUBDIVIDED TRANSFORMERS.

THE very interesting and valuable articles on the history and development of transformers by Mr. Kennedy, which appeared some months ago in your valued paper, have made me desirous of having the following note published.

Some time ago Mr. Kennedy described in chronological order the different patents in the ELECTRICAL REVIEW; at that time the complete specification of my transformer had just been lodged, and consequently

Mr. Kennedy could neither know the contents of this patent or mention it. It is not surprising if several people have similar ideas, and independently arrive at equal results in the scientific world as is the case here. I preceded that gentleman in this idea by about five months, and starting a different way arrived at the subdivided transformer.

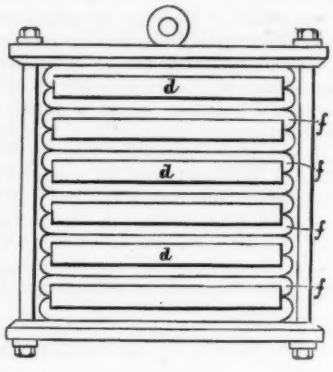



FIG. 1.

While Mr. Kennedy tried to develope the iron core by reducing the magnetic resistance, I gave the principal attention to the conductors which I wished to place in such a manner as to arrive at equal distribution of work in each layer, and therefore throughout the whole induction coil.

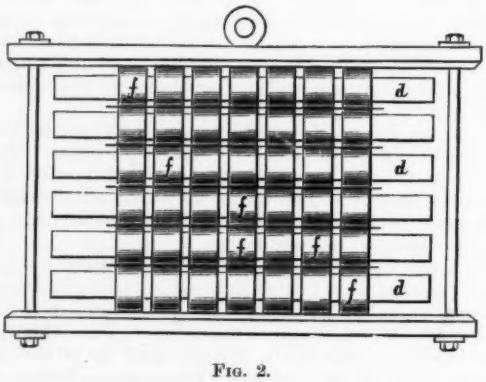



FIG. 2.

This type of subdivided transformer, which is the first patented in England, has several advantages over that mentioned in the former paper, and they will easily be recognised if I state before describing the apparatus its fundamental points of construction.

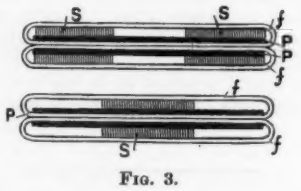



FIG. 3.

(1) Equal distribution of work throughout the transformer.

(2) Suppression of self-induction from one primary layer on others and from one secondary layer on the neighbouring.

(3) Greatest possible work with smallest amount of copper.

(4) Great radiating surface.

(5) Simplicity in construction, manufacture, and repair.

The first and third conditions are attained by keeping all layers equally close to the core; they will therefore have all equal (the shortest possible) lengths, and are placed in the most intense magnetic field, fig. 3; this is contrary to all former types, in which the superposed layers do less work per inch of conductor owing to their greater distance from the core (thereby being placed in a weaker magnetic field) and to the

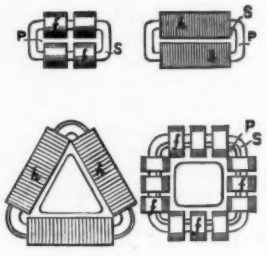



FIG. 4.

self-induction of the neighbouring layers. The second and fourth are fulfilled by reducing the superposed layers to a minimum (or nearly so) and by so arranging the core or cores that the different systems of conductors are separated by iron. Figs. 1 and 2.

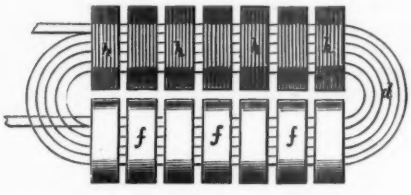



FIG. 5.

The fifth condition is achieved by the forms described below. Figs. 1 and 2 show two induction coils built of spirals 3, 4, and 5, 5a and 5b. Fig. 3 represents cross sections, fig. 4 end views, fig. 5 and 5b

FIG. 5a.

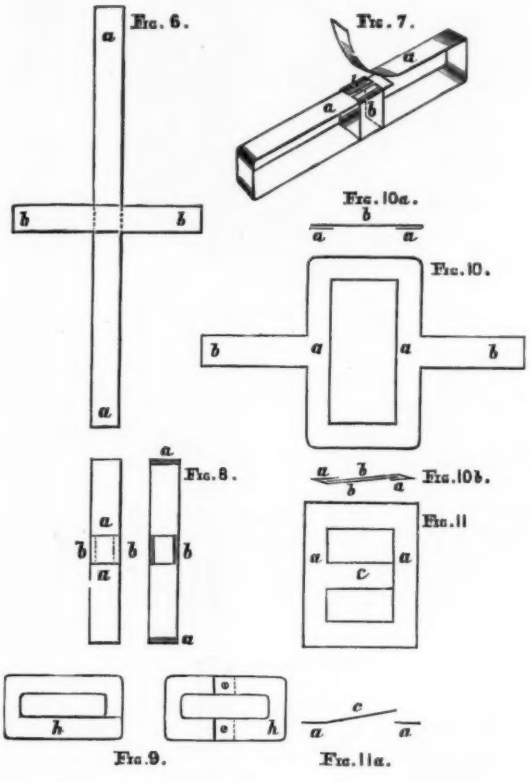
top views of some spirals or layers, and fig. 5a, a side view of the two last spirals or systems. In all figures, *d* indicates a system of primary and secondary layers; *f* cores of iron wire or strips, the latter with a flat side towards the spirals, *h* cores of strips standing on edge (fig. 9)

FIG. 5b.

P primary
S secondary
} wires.

Fig. 5b shows a new form of an iron core stamped out of sheets of iron or made of two strips forming a cross, fig. 6, of which the band, *a*, *a*, is passed on the outside of the layer, *d*, and *b*, *b*, lying in the central hollow space is connected to it as shown in figs. 7 and 8. If it is desired to place the cross on edge, the modified form, fig. 10, must be chosen; *a*, *a*, forms a complete loop which is slipped over the spiral, *d*, and the arms, *b*, *b*, are bent through the central hollow part of *d*, and connected to *a*, *a*, as shown in section 10a and 10b. Another modification developed out of form, fig. 10, is shown in figs. 11 and 11a.

To make this apparatus a commercial success it ought to combine simplicity and efficiency with cheapness, and the question arises, which is the core that combines these qualities?




Theory proves that iron wire, or strips placed on edge, are most efficient, and bands put flat on the spirals or layers are not so good; but practice shows that the latter cores are by far the cheapest (being less than one quarter in price compared with that of the former), and the difference in efficiency is but trifling, if the width of the strips is not large.

My system compares very favourably with that in the previous paper.

In the type described by Mr. Kennedy the subdivision is hardly complete, as there are six or more systems of coils on one core; besides, the magnet is complicated, and requires a great deal of work. It is a drawback to that system that the magnetic circuits are not complete in each core, especially if the closing is affected by placing the strips on edge. To obtain good contact in this way is difficult; as is well known, inefficient connection is the cause of the development of heat, and if the apparatus is not well bolted together, the magnetic reversals tend to cause an oscillating motion at these points which produce a loud humming noise; it is therefore evident that if great care is not taken in the manufacture of such a core, the power wasted will be much greater than that lost by Foucault currents in magnets like *f*. It is necessary, furthermore, that the core should be complete to be able to wind both the primary and secondary wires on to it, and in case of a breakdown, not only the burnt coil has to be undone but the whole core taken out, which necessitates the disconnection of several coils.

In the Gutmann transformers the primary and secondary layers are wound independently of each other and the core, and if the core is made of flat strips, *f*, it requires simply the bands to be cut to the desired length, a certain number, after being insulated, laid one over the other, passed through the central hole of *d* (figs. 1, 3, 4 and 5) and connected in form of concentric rings, or of a spiral; no bolts or screws are needed if the ends of the outside strips are well attached to each other.

Each layer is a safety fuse for the other part of the apparatus, and in case of a breakdown the burnt coil can easily be disconnected and replaced without affecting any other part of the transformer.

The manufacture is a very quick and inexpensive one, because the work of each induction coil can easily be distributed amongst several men, and very few tools are required.

Finally, I may state that subdivided transformers do not require greater space than types with a core common to all layers as may be thought, for when coils like fig. 1, working with 2,000 or 1,000 volts pressure in the primary and 100 or 50 volts respectively in the secondary, capable of supplying two to three horse-power, remain within the space of 15 inches by 6 inches by 4½ inches, they work well and silently and the temperature of the apparatus is negligible.

L. GUTMANN.

## THE WESTINGHOUSE ALTERNATING SYSTEM OF ELECTRIC LIGHTING.

(*Concluded from page* 367.)

Fig. 15 is a full-sized perspective view of the lamp socket and key, of which fig. 16 is an elevation, the outer casing being shown in section. Fig. 17 is a plan of the socket, the cap being removed, and fig. 18 is a section in the plane of the line, *x x*, in fig. 17. Fig. 19 is a perspective view of the same. A perspective view of the socket showing the key and switch is given in fig. 20. The various parts are supported upon a block of insulating material, A, upon one face of which is secured a cylindrical cap, B, having flexible resilient arms, *b*, adapted to grasp the semi-circular groove upon the lamp fitting, before referred to, when the lamp is shoved into its socket. The opposite face of the block, A, carries a metallic conducting bar, D, provided with a spring-jack device, $d^1$, $d^2$, adapted to receive and grasp the central contact tip of the lamp. The contact-spring, *e*, is brought into electrical connection with another similar spring, $e^2$, by means of a moving contact-piece, *e*, whenever it is desired to complete the circuit between the terminals, B and D, for the purpose of lighting the lamp. The contact-piece, *e*, is a metallic pin extending through the pivoted plate, K, but insulated therefrom. The standard, $K^1$, to which the plate, K, is pivoted, is affixed to a crank axis, *k*, provided with a thumb-piece, $k^3$. The plate, K, receives its motion through the intermediary of a spiral spring, *s*, attached at one end to the elbow of the crank axis, *k*, and at the other to an arm, $s^2$, projecting from the plate, K. When the crank-arm, *k*, is turned by the key, the end of the spring, *s*, is carried to one side or the other of the fulcrum of the plate, K, and thus the tendency is to pull the latter suddenly in the corresponding direction the instant it is over the centre. This snap-movement effectually prevents the formation of an arc between the terminals when the circuit is broken. A tube, $R^1$, of insulating material surrounds the switch mechanism, and secures it against accidental electrical contact with the metallic case, T. The cap is secured to the case by small set-screws, *o*, *o*, which enter slots forming bayonet joints on each side of the cap, as seen in fig. 15. It will be observed that the principle of the adjustable contact between the lamp and the socket in the Westinghouse lamp is precisely the same as that of the spring-jack device which has been so long in successful use in the telegraphic service, the simplicity and continued efficiency of which has been well established.

Fig. 21 shows a fitting designed to be attached to a reading or other portable lamp, and connected therewith by a flexible cord conductor. This is adapted to

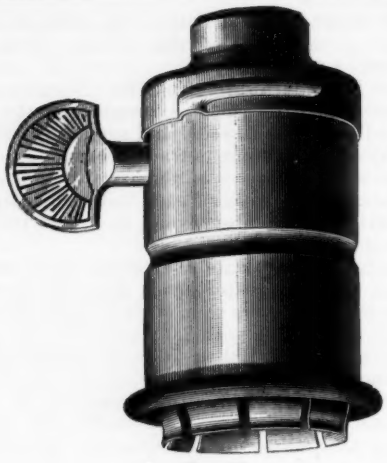


FIG. 15.

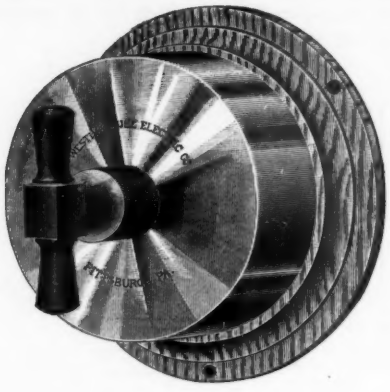


FIG. 23.

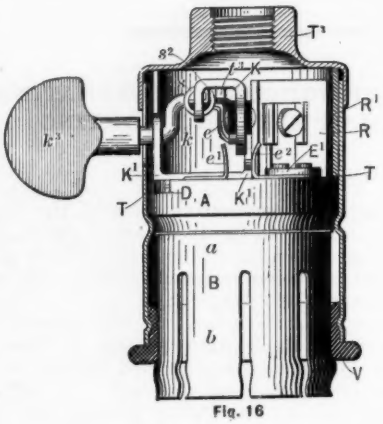



Fig. 16

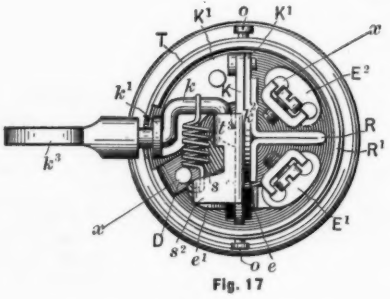



Fig. 17

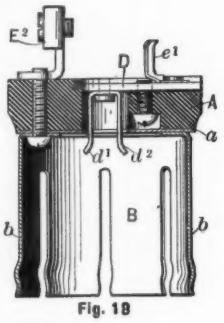



Fig. 18

FIG. 19.

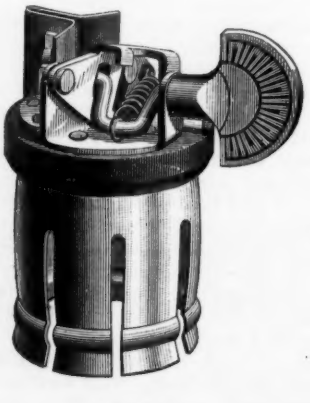


FIG. 20.

FIGS. 21 AND 22.

be inserted into any convenient socket from which a lamp has been removed, and will readily be understood without detailed explanation by referring to fig. 22, which shows the same device with its component parts separated in order to more clearly exhibit its internal construction.

Fig. 23 shows the external appearance of the switch which is designed to be placed in a building for turning off and on groups of lamps, either in the entire building or in any particular room.

The question of the arrangement of the converters in circuit for practical work is a very important one. The original plan of Gaulard and Gibbs was to extend a single main primary conductor throughout the district

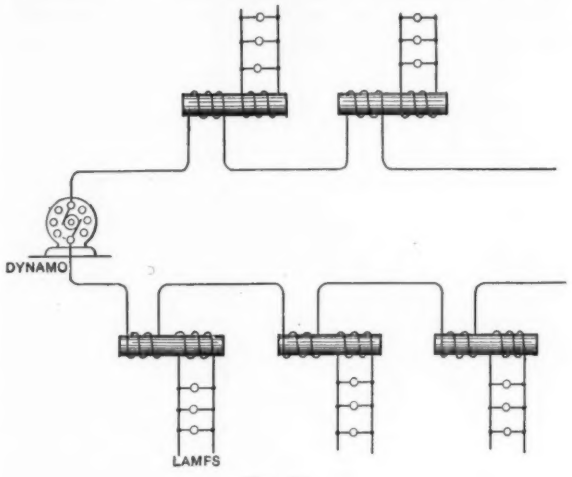



FIG. 24.

to be served, in which the primary wires of the secondary generators or converters were placed in series, in the manner illustrated in fig. 24. In the installation erected in 1885, in the vicinity of Regent Street, London, a double or looped wire was used in order not to interfere injuriously with the telephone service, and the converters were alternately put in one wire and the other all round the district, each pair of wires ending in a loop at a point remote from the station.

When the converters are thus arranged it is necessary to maintain a constant current in the circuit. No especial difficulty has been experienced in doing this, as the problem is substantially the same as that encountered in arc lighting, but another difficulty in the series system has always been to maintain a constant potential in the individual lamps. To effect this automatically turned out to be no very easy matter, and many ingenious devices designed for that purpose failed to accomplish their end, largely for the reason that, up to a very recent period, the theory of the action of converters had been but little studied except by specialists, and was not generally very well understood. A simple and effectual solution of the difficulty was found, by arranging the installation so as to bring the primaries of the converters in parallel arc with the generator. When thus situated any fluctuations in the strength of the primary current caused by variations in the amount of consumption in one or more of the secondary circuits, necessarily reacts upon the generator only, without traversing the primaries of any of the other converters, whereas in the series system every such perturbation, passing through all the primaries in the system, affected in a greater or less degree the current in every one of the secondaries connnected thereto.* The parallel system of distribution is shown in diagram in fig. 25, and is the one now adopted. It will be readily understood without further explanation. In practice the method of running the distributing circuits where aerial lines are employed is usually that illustrated in fig. 26. The poles are fitted with two cross-arms as shown in fig. 13, leaving room for the

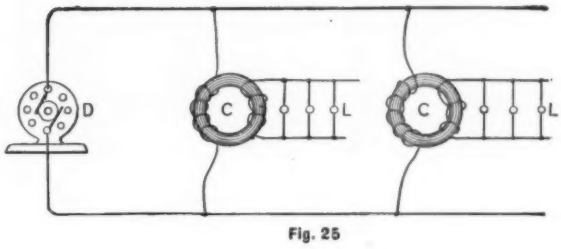



Fig. 25

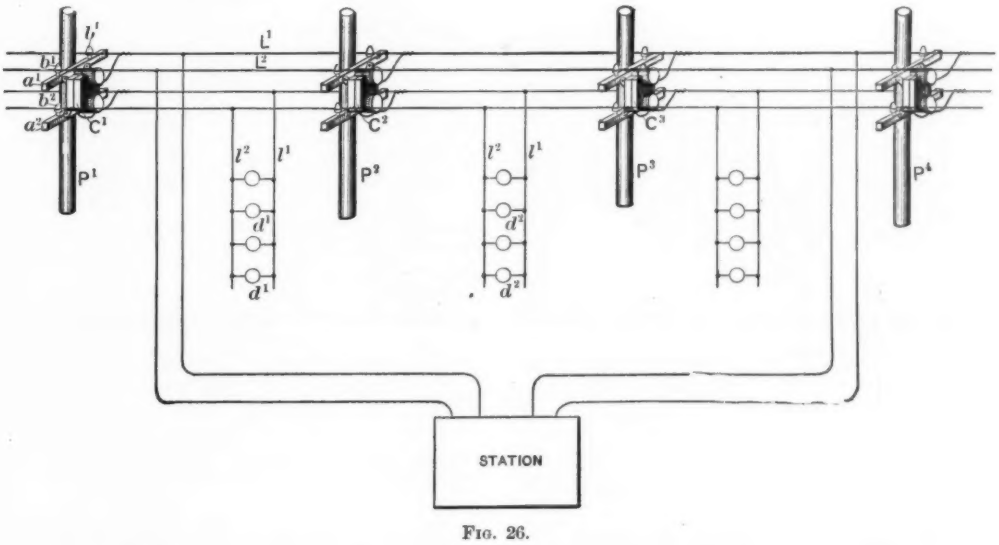



FIG. 26.

converter box between them. The upper cross-arm carries the main distributing conductors $L^1$ and $L^2$, upon insulators $b^1$ and $b^2$, while the secondary or consumption circuits are similarly carried upon the lower cross-arm. Instead of leading the secondary conductors directly to the point of consumption, the converters $C^1$, $C^2$, $C^3$, &c., upon the poles are connected directly to the consumption circuits on the lower cross-arm in parallel, and from these circuits the service wires 11 and 12 for supplying the lamps $d^1$ and $d^2$ in the adjacent buildings, are taken off as required. It is of course essential that an approximately equal difference of

* This arrangement was first pointed out, though possibly not first tried, by Rankin Kennedy, of Glasgow. His communications were published in the London ELECTRICAL REVIEW, June 9th and June 16th, 1883, Vol. XII., 486, 506.

potential between the secondary conductors, $S^1$ and $S^2$, should be maintained at all points, and this is effected without difficulty by locating the converters $C^1$, $C^2$, &c., at such points and at such distances apart with reference to the consumption circuit as shall effect this result. Each one of the several converters (as explained in connection with figs. 11 and 12) is provided with a cut-out plug switch, so that it can be connected to, or disconnected from the consumption circuit at a moment's notice when required.

It is not difficult to understand the reason of the economy in the cost of electrical distribution which is effected by the use of an alternating system worked at a high potential. Considering first the cost of installation, not only is the alternating dynamo much less expensive in its construction than the direct current machine, but the cost of the necessary auxiliary appliances at the central station is comparatively small, and above all the expense of the conductors throughout the system is enormously diminished, as will be readily seen in view of the fundamental law that the electrical energy traversing a conductor of given sectional area is directly as the square of the difference of potential at its terminals; and hence in working at a mean potential of 1,000 volts, as is ordinarily done in the Westinghouse system, only about one-thirtieth of the total weight of copper is required in the mains that would be necessary at the potential to which the direct current three-wire system is practically limited, namely, 200 volts. The diagrams, figs. 27, 28 and 29, exhibit this difference in a forcible manner, showing as they do, the actual areas of cross-section of the total mass of copper necessary to supply 5,000 16-C.P. incandescent lamps situated at a mean distance of 4,000 feet from the dynamo. Fig. 27 refers to the three-wire system, working at a potential of 200 volts with a fall of potential or loss of energy in the feeders of 10 per cent., the usual conditions under which this system is worked. Fig. 28 shows the conductor required for the same work in a Westinghouse installation wired for a loss in the feeders of 2.5 per cent., only one-fourth as much as the direct system. If this loss were increased to 10 per cent. to equal the loss in the direct system, the same work might be done on a wire of the size shown in fig. 29, but this would lessen the economy of working to an undesirable and unnecessary extent. It will of course be understood that the diagrams show the aggregate cross-section of all the feeders in each system, and not that of any single one.

The graphic diagram, fig. 30, shows in an equally striking manner the saving in the cost of the conductors which is effected by distributing at a high potential under the above conditions.

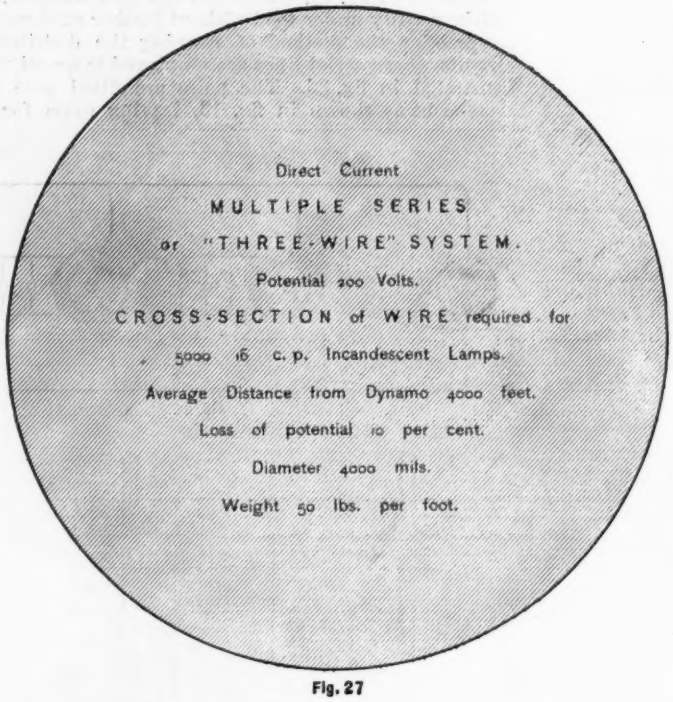
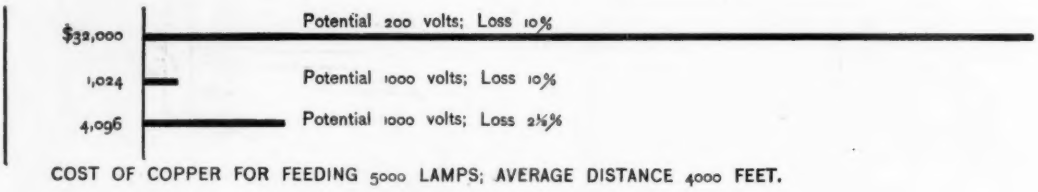

Direct Current
MULTIPLE SERIES
or "THREE-WIRE" SYSTEM.
Potential 200 Volts.
CROSS-SECTION of WIRE required for
5000 16 c. p. Incandescent Lamps.
Average Distance from Dynamo 4000 feet.
Loss of potential 10 per cent.
Diameter 4000 mils.
Weight 50 lbs. per foot.

Fig. 27

Fig. 28

Alternating current conversion system.
Potential 1,000 volts.
Cross section of wire for 5,000 16 C.P. lamps.
Average distance 4,000 feet.
Loss 10 per cent.

Fig. 29




COST OF COPPER FOR FEEDING 5000 LAMPS; AVERAGE DISTANCE 4000 FEET.

Fig. 30

The gain in economy of operation in the conversion system, though less apparent than in cost of installation, is nevertheless of great importance. The current in the consumption circuits is adapted to meet the requirements of a 50 volt lamp, which, by reason of its thicker filament, has a much longer life, and will bear a much higher energy of light conversion than the 100 volt lamps used in the direct system, so that it consumes 15 per cent. less energy per candle-power, a most important consideration. By reducing the fall of potential in the main circuits to 2½ per cent., the feeder equalizers, pressure indicators and complex wiring of the direct system are altogether dispensed with, together with the services of the special attendant required to manipulate these appliances.

Experience has demonstrated that the trifling loss of energy in conversion from high to low potential at the point of consumption is so much more than offset by the gain at other points, especially in the increased

efficiency of the lamps, that an alternating plant may be counted on to give 10 16-C.P. lamps per indicated horse-power, as against six to seven lamps per indicated horse-power by the direct system, which is equivalent to a saving of about 25 per cent. in the quantity of fuel necessary for operating the station.

Recent experiments have proved that the arc lamp may readily be adapted to work on the 50 volt current from the secondary of the Westinghouse converter, which renders the alternate system peculiarly well adapted to fulfil the requirements of a mixed incandescent and arc plant, such as is sometimes required in towns of moderate size.

## EDISON'S SYSTEM OF ELECTRICAL DISTRIBUTION BASED ON TRANSFORMERS.

OUR contemporary and namesake in New York professes to have been digging in the well of truth for information respecting the origin of transformer systems, and states as the result of its search, that right at the bottom it found several United States patents granted to Mr. T. A. Edison. The records which follow it published "without prejudice or desire to reflect or commend, but only in the interest of the true history of electrical progress."

Applications were filed by and patents granted to Mr. Edison as follows, in the order of filing :—

1. Electrical distribution system, No. 266,793 ; dated October 31st, 1882 ; filed December 9th, 1881.

2. Apparatus for the electrical transmission of power, No. 265,786 ; specification filed August 7th, 1882 ; dated October 10th, 1882. Consisting of rotating transformers in series and secondary circuits in multiple arc.

3. Apparatus for translating electric currents from high to low tension, No. 278,418 ; specification filed August 14th, 1882 ; dated May 29th, 1883. Induction coil apparatus, the primaries being in multiple arc, with constant potential direct-current mains, the secondary circuit being in multiple arc as usual.

4. System of electric distribution, No. 287,516 ; specification filed May 14th, 1883 ; dated October 30th, 1883. Rotating transformers in multiple arc, with the source of electric current.

The patents above noted, proceeds our contemporary, give a very full description of all the main features of the methods of distributing electrical energy as now practised, and after a careful reading of them it really seems only just to conclude that, as far as published records show, Mr. Edison is entitled to the honour of having been the first to comprehensively realise the importance of inductive distribution, and to devise, so far in advance, forms and methods whose practice and fulfilment the false prophets and sceptics of the hour forbade.

In our investigations we naturally felt curious to know what had been done by Mr. Edison towards the practical development of the inventions above noted. We find, practically, no change, merely a touch here and there as to mechanical details to fit the gauges of later refinement, and dress the child of 1881 in the fashion of 1887. And we present to our readers a description and figures by which will be seen the very full extent that the "motor generator," so called, of the original conceptions of Edison, goes into the field of economy.

In the interesting illustrations presented herewith, fig. 1 is a diagram representing the disposition of induction coils connected with the rotating alternating device, of which fig. 2 is a drawing.

The induction coils, H, J, K, L, M, N, O, P, are built up of a core of laminated iron, on which are wound two coils of copper, one of coarse wire, as shown by the heavy lines, for the secondary circuit, the other of fine wire for the primary circuit. The primary coils are connected, as also are the secondary. From each connecting wire are attached brushes, $B^1$, $B^2$, &c., for the primary, $b^1$, $b^2$, &c., for the secondary circuit. E and F are on the same shaft, and in a portion of their circumferences are inserted metallic contact pieces, A, D, C, G. A and G are joined with two continuous rings, on which press brushes, connected with the dynamo circuit. As the shaft revolves, brushes, $B^7$, $b^7$,

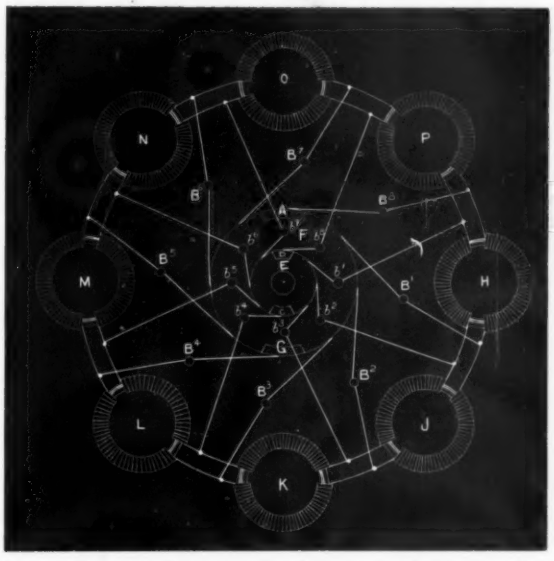



FIG. 1.—EDISON'S TRANSFORMER SYSTEM OF ELECTRICAL DISTRIBUTION.—ARRANGEMENT OF INDUCTION COILS AND COMMUTATING ALTERNATOR.

and $B^3$, $b^3$, will touch the metal sections, A, D, C, G. The direction of the current will, therefore, be reversed in the primary coils of O and K, and induced currents generated in the secondaries of the same coils, which

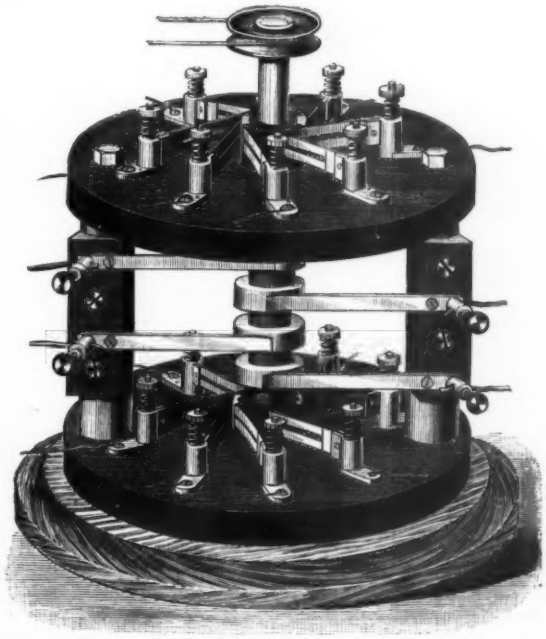


FIG. 2.—EDISON'S ALTERNATOR USED WITH HIS TRANSFORMER SYSTEM.

will be taken off by the brushes, $b^7$, $b^3$, conveyed to two rings, and thence by brushes to the local lamp or motor circuit. As the rotation continues the current in the primaries of the coils is in succession reversed, and the induced current in the secondaries commutated. The transformers are connected in multiple

arc with the dynamo circuit as shown, by the patent No. 278,418, May 29th, 1883, a series system being extremely difficult of regulation. They may be described as a lot of closed magnetic converters arranged in a crown, constituting a compound alternating and converting device, the commutation being obtained practically as in the coils of a Gramme ring. According to the ratio of the number of turns on the primaries and secondaries, the electromotive force can be raised or lowered. For long distance transmission, using a continuous current of high tension, small conductors only are needed. This current is converted into a continuous current of low tension for incandescent lamp or motor circuits. Reversals of the current are made so rapidly (100—200 per second) that the iron cores are never fully magnetised and the percentage of conversion is remarkably high. If the primary coils be supplied with current of constant potential the apparatus is self-regulating, and the slight variation of the potential of the secondary circuit is due to the resistance of the wires. Less than the energy of one 16 candle-power lamp is required to operate a motor driving the rotating shaft to commutate current of 200 ampères.

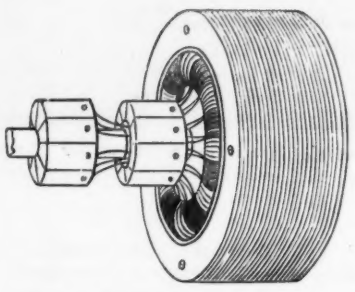


FIG 3.—ROTATING TRANSFORMER.

Fig. 3 represents a modification of this device. The primary and secondary coils are wound upon one iron core precisely as in a Gramme ring. Outside the whole is a mass of laminated iron, which is stationary, to concentrate the lines of force upon the copper wire. The primary coils of fine wire are connected with the commutator at the end of the shaft, and secondary coils of coarse wire with the remaining commutator.

The coils and shaft revolve. Brushes convey current to the primary coils, the current being reversed in each coil twice in each revolution. The reversals of the induced currents in the secondary coils, occurring at the instant the coil passes from left to right hand side, as in a Gramme ring. The above device was patented on May 29th, 1883, No. 274,418.

Mr. Edison's United States patent 265,786, dated October 10th, 1882, describes a system for the distribution of electrical energy in which one set of armature coils of a number of the rotating transformers are connected in series with the dynamo supplying the current. In the secondary circuits of the transformers are placed incandescent lamps or other apparatus. By this system the expense for conductors on long circuits is materially reduced over that of low tension multiple arc distribution. Owing to the difficulties of regulation, Mr. Edison patented October 30th, 1883, No. 287,516, a system of electric distribution consisting of motor generators or transformers, the primary circuits of which were connected in multiple arc with the dynamo circuit as shown in the diagram, fig. 4.

Dynamos, D, D, D, D, connected as usual in the three-wire system, are wound to generate currents of high electromotive force, admitting of the employment of small conductors. The three wires, F, E, N, are connected at the sub-station with the primary circuits of the armature of the converters or transformers. The current for the field magnets of the dynamos passes through the wires, B, B, the rheostats, R, R, which are at the sub-station, returning over the neutral wire, N. The wires, B, are very small, preferably of iron for economy, and the slight loss of energy in them is of no consequence compared with the convenience of regulating from the sub-station the potential of the current supplied to the converters. The three-wire system is advantageous because the insulation of dynamos and converters will be subjected to one half the potential of a two-wire system, and because the distribution from the sub-station is easily made on the three-wire system, and economy of conductors and increased area of distribution obtained.

The current is collected from the commutators, S, S, of the secondary coils of the converters, and is distributed exactly as if the armatures of the converters were driven by an engine instead of a current of electricity from a distant source.

From the indications of the ammeters, A, and volt-

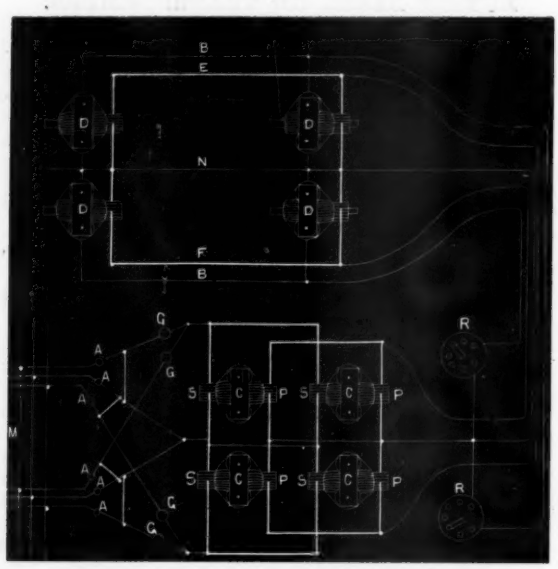



FIG. 4.—EDISON'S PLAN OF ROTATING TRANSFORMERS. THE PRIMARY CIRCUIT CONNECTED IN MULTIPLE ARC WITH THE DYNAMOS.

meters attached to pressure wires leading from desirable points on the distributing mains, the attendant at the sub-station regulates the potential of the distributing mains, M, by the feeder regulators, G, and the rheostats, R. By the use of the latter it is unnecessary to run back pressure wires from the sub-station to the dynamo station.

Transformers or motor generators look like dynamos. The armatures are wound with two sets of coils, large and small. As their name indicates, they are electric motors, the converting armatures revolving in a powerful field, by the influence of the current passing through their primary circuits. This disposition proves a potent factor in the economy of the system. As there is no belt strain, well balanced armatures are run at double the speed of a dynamo of the same size. The output is therefore twice that of a dynamo of the same size. At an outlay of 50 per cent. of the cost of the dynamos of the central station, converters can be placed in a sub-station and current distributed four miles instead of less than a mile from the power plant, and at no greater expense for conductors.

The motor generators require much less attention than a dynamo with well-balanced armatures; the weight alone of these causes any friction on the bearings. The number of ampères of the high and low tension circuits of the armature is approximately the same. Any tendency to distort the lines of force and cause a rotation of non-sparking point in a negative direction by the high tension or motor coils is neutralised by the current (flowing in opposite direction) of low tension or dynamo coils. There is absolutely no sparking at the brushes of either commutator, and

the brushes, when once adjusted, require no change for any variations of load.

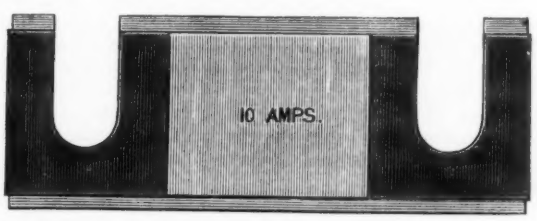
The field magnets for transformers are inexpensive. A 100-light induction coil converter, costing $200 for alternating currents, when placed in a field, costing $100, and used as a dynamo converter, will run 1,000 lights, and the output is limited only by Foucault currents.

As a complete exposition of the principles embodied in the foregoing patents, a station is in process of construction at Llewellyn Park, one of the most beautiful suburbs of New York.

Dynamos of 600 volts each will be used, giving 1,200 volts pressure between the positive and negative leads. From the sub-stations lamps and motors suited to 100 and 200 volt circuits will be supplied with a uniform current at constant potential, which can be as easily metred as in systems in which the current is distributed directly from the dynamos. The plant will be installed in Mr. Edison's new laboratory, which will undoubtedly be, when completed, the most extensive electrical laboratory in the world, where the distinguished inventor, with his talented associate, Mr. E. T. Gilliland, will prosecute experiments in electrical work. Underground cables are to connect with sub-stations at "Glenmont," the inventor's residence, 400 lights, and with several residences in the vicinity. A converter will be placed in each house.

## HEDGES' PATENT SWITCHES AND MICA FOILS.

IN the ELECTRICAL REVIEW of March 25th will be found a description of the most recent type of Hedges' Patent Switches. The vulcanised fibre which supported the contact in these switches has been found to be an objection when the switch was fixed in a damp situation, owing to the moisture causing it to swell and thus interfering with the action of the switch, to say nothing of other obvious objections to the presence of moisture. In the instruments which have been submitted to us the fibre is entirely done away with, and no support at all is required for the contact when in the "off" position, this being effected by a very simple device. A neat form of spring is also so arranged that it is impossible to leave the switch partly on.




The accompanying illustration of the new mica foil explains itself, and is decidedly an improvement on the former plan of making the contact through two eyelets, as the slots permit of a new foil being fitted without necessitating the removal of the contact screws. We think that these mica foils will be found quite as handy to use as lead wire, and, according to Mr. Hedges, they do not run into globules when melted as the thin particles of foil stick to the mica, and, therefore, the foils can be used without slate bases.

## WEIGHT AND OUTPUT OF DYNAMOS.

THE interesting figures which follow are culled from the paper of Lieut. T. B. Murdock on "Electric Light for the New Cruisers," read before the National Electric Light Association in Boston.

TABLE I.—AMERICAN DYNAMOS.

| Dynamo. | Revolutions. | Watts in external circuits. | Watts per pound. |
|---|---|---|---|
| Edison, No. 20 | 800 | 50,000 | 6·0 |
| Brush, H. 3 | 850 | 66,000 | 9·4 |
| American, 50 light | 875 | 21,600 | 5·7 |
| Westinghouse, No. 18 | 900 | 30,000 | 5·4 |
| Hochhausen, No. 8 | 1000 | 35,200 | 8·8 |
| Mather, 500 lights | 1050 | 35,250 | 7·4 |
| Weston, 6 W. I. | 1050 | 11,500 | 4·1 |
| Brush, G. 4 | 1050 | 28,300 | 9·3 |
| American, 16 light. Hie | 1075 | 6,480 | 4·8 |
| Weston, 7 W. I. | 1100 | 20,125 | 6·5 |
| Westinghouse, No. 12 | 1100 | 18,000 | 4· |
| Brush, F. 5 | 1100 | 19,000 | 8·5 |
| Thomson-Houston, H. I. | 1150 | 25,600 | 6·1 |
| Edison, No. 12 | 1200 | 30,000 | 6·9 |
| Hochhausen, No. 6 | 1200 | 17,600 | 8· |
| Thomson-Houston, E. I. | 1250 | 13,200 | 5·8 |
| Mather, 400 lights | 1300 | 28,100 | 7·0 |
| Edison, No. 8 | 1400 | 20,000 | 6·9 |
| Thomson-Houston, C. I. | 1500 | 6,000 | 5·6 |

TABLE II.—EUROPEAN DYNAMOS.

| Dynamo. | Revolutions. | Watts in external circuits. | Watts per pound. |
|---|---|---|---|
| Manchester, No. 6 | 350 | 9,000 | 3·6 |
| Victoria, H. 3 | 350 | 36,000 | 9·7 |
| Siemens & Halske | 350 | 16,000 | 8·1 |
| Edison-Hopkinson, 10 in L. | 350 | 16,800 | 2·9 |
| Manchester, No. 7 | 400 | 22,500 | 4·6 |
| Victoria, F. 3 | 400 | 21,600 | 8·6 |
| Siemens & Halske | 400 | 20,000 | 10·2 |
| Edison-Hopkinson, 15 in S. | 420 | 39,600 | 3·4 |
| Gramme, H. 2d 225 | 450 | 23,600 | 8·3 |
| Elwell-Parker | 450 | 50,000 | 5·6 |
| Crompton, $\frac{40}{110\ J}$ | 460 | 45,100 | 6·7 |
| Edison-Hopkinson, 8 in L. | 525 | 15,400 | 3·3 |
| Manchester, No. 5 | 525 | 6,500 | 4·7 |
| Crompton, $\frac{22}{110\ J}$ | 550 | 24,750 | 6·0 |
| Manchester, No. 6 A. | 550 | 25,000 | 6·75 |
| Edison-Hopkinson, 10 in L. | 550 | 25,200 | 4·4 |
| Victoria, D. 2 S. | 600 | 8,400 | 6·7 |
| Gramme, H. I. c 200 | 600 | 14,000 | 6·4 |
| Ganz | 670 | 50,400 | 9·2 |
| Crompton, $\frac{60}{110\ J}$ | 675 | 66,000 | 9·8 |
| Goolden-Trotter | 765 | 16,000 | 6·2 |

TABLE III.—EUROPEAN AND AMERICAN DYNAMOS.

| Dynamo. | Revolutions. | Watts in external circuits. | Watts per sq. inch floor space. |
|---|---|---|---|
| Manchester, No. 6 | 350 | 9,000 | 4·9 |
| Edison-Hopkinson, 10 in L. | 350 | 16,800 | 6·9 |
| Manchester, No. 7 | 400 | 22,500 | 6·0 |
| Edison-Hopkinson, 15 in S. | 420 | 39,600 | 9·1 |
| Crompton, $\frac{40}{110\ J}$ | 460 | 45,100 | 20·3 |
| Edison-Hopkinson, 8 in L. | 525 | 15,400 | 6·5 |
| Manchester, No. 5 | 525 | 6,500 | 4·6 |
| Ganz | 670 | 50,400 | 20·9 |
| Crompton, $\frac{60}{110\ J}$ | 675 | 66,000 | 26·4 |
| Edison, No. 20 | 800 | 50,000 | 8·8 |
| Brush $H^3$ | 850 | 66,000 | 23·5 |
| Westinghouse, No. 18 | 900 | 30,000 | 5·8 |
| Hochhausen, No. 8 | 1000 | 35,200 | 15·0 |
| Mather, 500 Lt. | 1050 | 35,250 | 8·5 |
| Weston, 6 W. I. | 1050 | 11,500 | 4·4 |
| Brush, $G^4$ | 1050 | 28,300 | 17·7 |
| Weston, 7 W. I. | 1100 | 20,125 | 5·4 |
| Westinghouse, No. 12 | 1100 | 18,000 | 4·7 |
| Brush, F 5 | 1100 | 19,000 | 15·3 |
| Thomson-Houston, H. I. | 1150 | 25,600 | 9·0 |
| Edison, No. 12 | 1200 | 30,000 | 7·7 |
| Hochhausen, No. 6 | 1200 | 17,600 | 13·3 |
| Thomson-Houston, E. I. | 1250 | 13,200 | 8·2 |
| Mather, 400 light | 1300 | 28,100 | 7·3 |
| Edison, No. 8 | 1400 | 20,000 | 6·0 |
| Thomson-Houston, C. I. | 1500 | 6,000 | 5·9 |

TABLE IV.—EUROPEAN MACHINES.

| | Plant. | Connection. | Total weight. | Floor space. | Weight per 16c. lamps. | Sq. in. of floor space per 16c. lamps. |
|---|---|---|---|---|---|---|
| | 1-200 light Brush compound ... ... ...<br>1-8 inch Brotherhood ... ... ... ... | Direct. | 5·500 | | 27½ | |
| Steam yacht *Restless.* | 1 Arnold dynamo (30 lights) ... ... ...<br>1 Vertical engine ... ... ... ... | Friction. | 600 | 6 sq. ft. | 20 | 29 |
| | 1 Goolden-Trotter dynamo (75 lights) ...<br>1 Tower engine ... ... ... ... ... | Direct. | 900 | 5¼ | 12 | 11 |
| | 1 Victoria dynamo (60 lights)... ... ...<br>1 Brotherhood ... ... ... ... ... | Direct.<br>765 revs. | 800 | $4\frac{8}{10}$ | 13 | 11 |
| Italian cruiser *Dugali.* | 1 Parson's dynamo (150 lights) ... ...<br>1 Parson's steam turbine ... ... ...<br>(3 plants like above.) | Direct.<br>9,000 revs. | 900 | 6¼ | 6 | 6 |

TABLE V.—AMERICAN MACHINES.

| | Plant. | Connection. | Total weight. | Floor space. | Weight per 16c. lamps. | Sq. in. of floor space per 16c. lamps. |
|---|---|---|---|---|---|---|
| U.S. steamer *Chicago.* | 2 Edison No. 8 (200 lights) ... ... ...<br>2 Armington & Sims ... ... ... ... | Belting. | 16·000 | | 40 | |
| U.S. steamer *Boston.* | 1 Brush compound (150 lights) ... ...<br>1 Straight line ... ... ... ... ... | Belting. | 10·400 | | 70 | |
| U.S. steamer *Atlanta.* | 1 Weston 7 W. I. (150 lights) ... ... ...<br>1 Armington & Sims ... ... ... ... | Belting. | 6·500 | 105 sq. ft. | 43 | 101 |
| Steam yacht *Alva.* | 1 Siemens compound (160 lights) ... ...<br>1 Willans' engine ... ... ... ... | Direct<br>450 revs. | 6·700 | 27 | 43 | 24 |
| French ironclad *Indomptable.* | 2 plants each ... ... ... ... ...<br>1 multipolar Gramme (160 lights) ... ...<br>1 vertical compound engine ... ... ... | Direct<br>350 revs. | 7·040 | 29 | 44 | 26 |
| Torpedo station | 1 Brush No. 7 special (100 lights) ... ...<br>1 Westinghouse ... ... ... ... | Direct<br>700 revs. | 4·000 | 17 | 40 | 25 |
| Torpedo station | 1 Weston No. 8 special (270 lights) ... ...<br>1 Westinghouse automatic ... ... ... | Direct<br>390 revs. | 9·300 | 75 | 42 | 41 |

## ELECTRICITY AND WATER POWER.

No improvement in the science or practice of electricity would be of equal interest to electricians, or the public, or would have the same effect in popularising its agency, and extending its employment to countless purposes which now seem beyond its scope, as would any feasible means of largely reducing the cost of its production.

Whatever may be the future of the various attempts to produce electrical energy cheaply by chemical action, it is a matter of common knowledge that hitherto it has been impossible to produce it at commercial prices, except by the employment of steam power.

Now, steam power, greatly as it has been improved and cheapened of late years, is still, and ever must be, a costly raw material, if one may so call it.

It is, however, in the highest degree desirable that electricity should be used, and used universally as a motive power, not only from æsthetic, but from very practical considerations. Its unlimited capacity of transmission, within reasonable distances, and of distribution to suit all requirements, its freedom from dirt, noise, heat, and smoke, the small size and cheapness of the plant, a little electro-motor in a corner of a factory floor replacing boilers and engines, boiler and engine house and chimney shaft, with its cloud of black smoke, the fact that its full force is available the instant it is wanted, and need not be employed one second after its work is done, the motors themselves, like sentient beings, regulating their consumption of electrical energy by the work they have to do, all these point to it as the ideally perfect motive power, and lead one to consider seriously whether it may not be possible, to some extent, to supersede the steam engine, by calling to our aid the great forces of nature now going to waste all round us, and setting them to do some part, at least, of the work which our 7,000,000 of steam H.P. do at such cost in money and comfort.

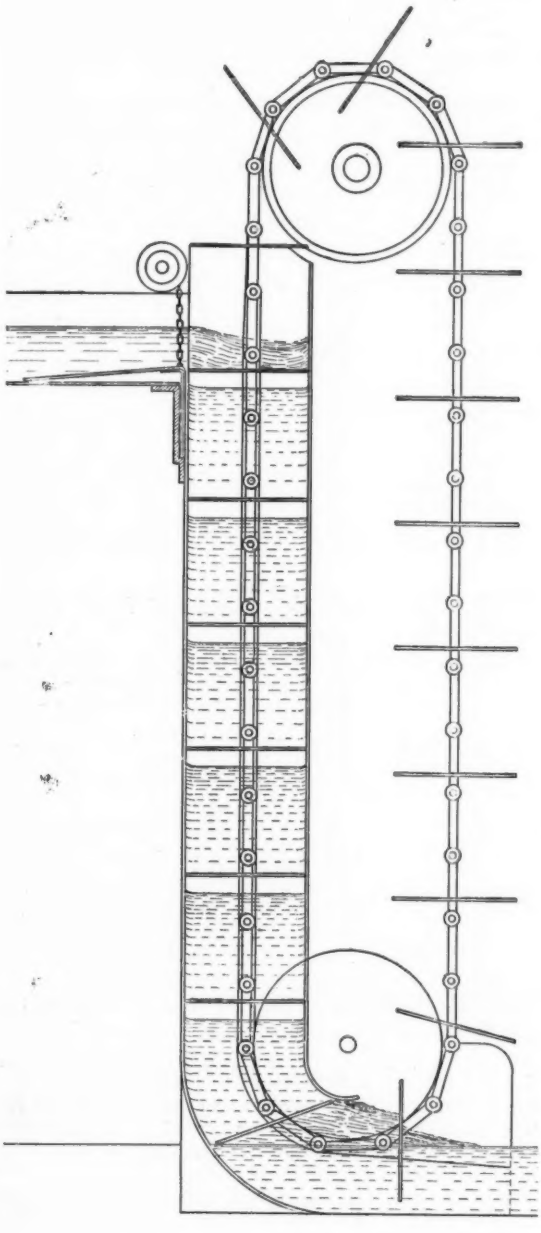
Of these natural forces but one seems at all practically available and that is water power. It may surprise our readers that we speak of water power as a probable source of any considerable amount of force, but we think its capabilities are very generally overlooked. There are believed to be nearly a million H.P. of water power now imperfectly used in the United Kingdom, yielding possibly not half that total of effective force, and there is quite as much going to waste, chiefly because there is no demand for it where it is found.

Now, the question of position is often fatal if the work has to be carried to the power, but is no bar to its use for electrical purposes, where the power is carried to the work. All this water power might be largely increased in the hilly districts which form nearly the whole of Scotland and Wales, and no inconsiderable part of England and Ireland by the construction of reservoirs to impound flood waters, and we see no reason why all the water power of the kingdom should not be got and delivered at much less than £5 per H.P. per annum, steam power being worth nearer £20.

The tidal power in the estuaries we leave out of consideration, as, though it is practically unlimited, no one has yet made known a feasible means of obtaining it.

We are led to these remarks by having lately seen a water motor patented by Mr. Sealy Allin, for which an unprecedented efficiency is claimed, exceeding even 90 per cent. This point of efficiency has of course a highly important bearing on the value of water power, as there is little doubt one chief reason why it has been so neglected hitherto, is the comparatively low efficiency of the motors (motor wheels and turbines) used to obtain

it. Mr. Sealy Allin's motor is very simple in construction. It consists of a series of flat floats carried between a pair of endless chains gearing into a pair of wheels on the main shaft at top, and passing down a casing round guide pulleys at bottom. The power is taken from the main shaft which, revolving with the chains and floats, travels at three to four times the speed of the shaft of a water wheel. At each side of the casing is a guide groove down which the chains travel, fitting them closely and so preventing any contact between the floats and the casing, to which besides there is no tendency, as the floats are mounted centrally and the centre of gravity of the whole series being under their



point of suspension they naturally hang and travel plumb. The water is taken in at the highest point and discharged at the lowest, exercising its full force during its descent, and we cannot see that there is any appreciable loss, except the friction of the machine itself.

It will be seen from the sketch that the apparatus resembles the old chain pump reversed, and we shall be glad to learn from any of our readers who have had experience with water motors, whether they consider the claims of Mr. Sealy Allin well founded. The object of the inventor has been to produce a motor which should escape the great loss of fall made by the water wheel, and the excessive pressure, skin friction, and wasted energy of the turbine. In a pamphlet addressed to the users and owners of water power, Mr. Sealy Allin volunteers to erect a motor on any fall down to 10 feet, and to make its yielding an efficiency of 90 per cent. a condition of purchase. We trust that persons may be found ready to accept such a handsome offer, and that Mr. Allin may afterwards have no reason to go back on his conviction, that he has produced the most simple and efficient water motor in the market.

Mr. Sealy Allin claims, too, that the motor is applicable to tidal power as well as to the ordinary river power, and if it be so, he has certainly a very wide field open to him.

## BRIGHTON ELECTRIC RAILWAY.

ON Thursday, at the Brighton Town Council, the question of Mr. Volk's electric railway at Brighton again formed the topic of a long and animated discussion. A special report on the subject was submitted by the Works Committee, who reported the receipt of a letter from Mr. Magnus Volk, substituting for his application to the committee in March last, the following :—"To meet the objections which have been urged against the railway in its present form, I purpose, with your approval, in the next Session of Parliament, to apply for an Act or Provisional Order to construct an electric railway on the beach from the present terminus to a point near the Chain Pier, then by a tunnel or covered way under the Madeira Road, then by an open cutting close to the sea wall, thence rising a gradient of one in twenty to a level about 10 feet below the level of the Marine Parade, and thence along the sea wall to a point near Chichester Terrace. It is proposed to erect the line on wrought iron lattice girders supported on pairs of iron brackets of an ornamental nature, to be coupled together at a distance of 40 feet. By this means a light structure wholly of iron could be placed in such a position that none of the objections urged against the present railway would have any weight. It would not obstruct the view at any point, and for the greater portion of the distance the cars themselves could not be seen, except by leaning over the fence of the Marine Parade. It would not occupy one foot of ground, no smoke or anything of an objectionable nature would arise therefrom, and it would have the convenience of enabling passengers by ascending a few steps to reach the level of the Marine Parade. The proposed railway would cross the steps in the manner shown upon the plan accompanying this application. If the Council approve of this application I shall be prepared to pay to the Corporation :—1. For rental of the arch now used by me. 2. To pay a rental of 10 per cent. on the net proceeds of the railway. 3. In the event of the Corporation wishing to take over the line themselves, to enter into an agreement that they shall be at liberty to do so on payment of 15 years' purchase of the net proceeds, based upon the proceeds of the preceding three years; such sum not being less than £5,000 nor more than £10,000."

With reference to this new proposal by Mr. Volk, the Committee submitted a report from the Borough Surveyor, who expressed the opinion that the electric railway was an attraction to the town and deserving of encouragement, but it was a matter for very grave consideration whether the Town Council should allow private individuals to acquire permanent rights on the beach or upon important public structures like the Marine Parade wall. Whatever was done, he thought that the Corporation should retain entire control over the undertaking and that monetary interests should be rendered subservient to plans for the general and permanent improvement of the place. The carrying of the railway so near to the top of the wall was not desirable. It would materially alter the character of the structure, and the rise of one in twenty to get up to that height for a length of 830 feet was objectionable. The railway would be less obtrusive, and altogether more convenient, if it were placed on a terrace 12 to 20 feet from the ground, which would itself make an agreeable promenade. He had prepared a sketch plan showing how this could be done. The part from the Aquarium to the Chain Pier would be nearly the same as at present, but there would be a regular inclination of one in 123 down from the terminus to the pier, and a tunnel crossing under the Madeira Road which would be nearly level. Thence the gradient would be one in thirty for about 600 feet, rising to a height of 10 feet above the ground at Grafton Street step, thence one in 1,060 to the arch east of the Crescent steps, then one in 245 to Paston Place steps, and from Paston Place to opposite Chichester Place one in forty. The railway would there terminate on the level of the Marine Parade at the first balcony west of Lewis Crescent. The terrace would be about 20 feet in width, eight feet of which nearest the wall would be occupied by the railway, which would pass in front of the steps, the lower flights of which would be

carried over the railway and down on the outside of the terrace, so as to communicate either with the Madeira Road, the terrace, the railway, or the Marine Parade. The railway would be separated from the terrace by a fence and would be in every part shut off from the public highway, but communications could be made at any point from the terrace to the railway, and especially the spaces in front of the steps could be used to take up or set down passengers.

Following the Surveyor's report, the Committee expressed satisfaction that the electric railway had been a source of amusement and attraction to visitors, as well as a convenience to many inhabitants, and were of opinion that it was desirable that the present railway or some modification of it should be continued. They recommended that Mr. Volk should be informed that the Council approved generally of his proposal to reconstruct the railway, except that they considered that the level at which the new railway should run should be 20 feet below the top of the Marine Parade wall, and that they would require some alteration of the plans. The conditions upon which the Council would agree to the proposal must be reserved for consideration until the clauses of the projected Bill were submitted to them.

Alderman SENDALL, after the adoption of the report had been moved and seconded, submitted an amendment to the effect that Mr. Volk should be informed that the Council approved generally of his proposal to reconstruct the electric railway (the part eastward of the Chain Pier being changed to a position north of the Madeira Road), and providing all details of the scheme were clearly set forth and submitted to the Council for approval, and that the terms and conditions proposed were acceptable to them, they would be willing to agree to such reconstruction.

Alderman ABBEY seconded, and after some discussion, the original motion was withdrawn, and the amendment became the substantive resolution.

Alderman BENNETT then moved as an amendment that it was undesirable to allow anyone to acquire legal rights over the Madeira Road or the wall abutting thereto.

During the discussion which ensued, it was contended by those supporting the amendment that by passing the resolution they would give Mr. Volk a permanent right over the Madeira Road, which could only be destroyed by their buying up the railway at his own price. It was generally admitted that the railway was a great convenience and attraction, but Councillor BERRY described it as the "greatest curse ever brought to the east of Brighton."

The MAYOR (Alderman Reeves), held that if they passed the motion they would take away their right of opposing the Bill at the committee of the House of Commons. He could think of no more fatal blow to the town than the sanctioning of such a proposal. Eventually the amendment was adopted by 36 to 6.

## ELECTRICAL PROPULSION.

A TWO-FOLD demonstration of the application of electric motive power was made on Wednesday in East London. The first was the running of electrically propelled tramcars from Stratford Church to Manor Park, and the second a trial trip of the Elieson Company's electric launch, the *Countess*, in the Albert Dock. On the above named section of the North Metropolitan system, the Elieson Company's engines, driven by stored electrical energy, have been at work alternately with those drawn by horse-power since August 6th, and in that interval have run 14,000 car miles and conveyed 140,000 passengers at a cost which is declared to be less than that of horse traction.

It is needless for us to recapitulate the essential features of the Elieson system, for they must be perfectly familiar to readers of the REVIEW, and it is enough to say that the experiments of Wednesday passed off without a hitch of any kind and to the satisfaction of everybody present. The launch also has been noticed by us, so it will suffice to add that her propelling plant is precisely similar in principle to that in use on the locomotives.

Amongst the visitors who were present at the trials, and who were afterwards entertained at a luncheon at the Galleons Hotel, the Earl of Galloway, chairman of the company, presiding, were the Secretary of the Turkish Embassy; Captain Schröder, Naval Attaché of the German Embassy; Lieutenant Heurtel, Attaché of the French Embassy; Hon. Adye Douglas, Agent-General of Tasmania; Major Isaacs, M.P., Prof. Perry, and Professor Silvanus Thompson, Mr. Allbright, Mr. Kapp, Mr. Raworth, Mr. Beaumont, Mr. Stetson of New York, Mr. C. Morton of New York and London, Mr. Rawson, Mr. Scott Russell, and between 30 and 40 others, including representatives of the Press.

In responding for the Colonies, the Hon. Adye Douglas gave a glowing account of the picturesque beauty and great resources of Tasmania, and said that the Australasian world was greatly interested in the development of electricity as a motive power. *En passant* we may here remark that we never so thoroughly understood until Wednesday what a dreadfully irritating little quadruped the "Tasmanian Devil" must be. It is said to be scarce, for which the Colonists have much cause to be thankful.

Major Isaacs, speaking as a director of the District Railway, fervently hoped for the time when the use of electric locomotives would give travellers on the underground systems of the metropolis a purer and more comfortable atmosphere, and he seemed very much in earnest in his belief that we need not look very far into the future before this consummation will be complete.

Prof. Silvanus Thompson and Prof. Perry congratulated the company on its progress, and spoke hopefully of the future.

One thing only now remains. Let us know within, say, a halfpenny per car mile what amount the running expenses entail; the eventual result of the experiments can then be easily foreseen. In the meantime, the company may rest assured of our hearty support.

## NOTES.

**Electric Lighting at Torquay.**—Experiments are being made at the Royal Public Hall, Torquay, with the view of testing the efficiency of the electric light for stage purposes, and it will probably be adopted as part of a scheme for increasing the safety of the building.

**Compulsory Electric Lighting.**—A novel course has been adopted by the owner of an estate in a popular suburb of Chicago, which is being leased for building purposes. He stipulates in his agreements that the houses erected shall be lighted by glow lamps, and that no other means of illumination shall be employed.

**Electric Lighting of Trieste.**—The Vienna correspondent of the *Daily Chronicle* states that the Municipal Council of Trieste has decided to introduce electric lighting into the town.

**Electric Lighting at Hastings.** — On Friday at Hastings Town Council the special Public Lighting Committee recommended the renewal for another year of the existing contract with the Electric Light Company for the lighting of the front from the Queen's Hotel to Warrior Square, by means of arc lamps of 2,000 (nominal) C.P. for the sum of £450 per annum. A discussion ensued, during which Mr. Eaton spoke in favour of large gas lamps being used, by which he asserted £200 a year might be saved. An amendment in favour of gas was then moved by Mr. Jenner (who said that electricity had cost the town £1,200 during the last three or four years) and seconded by Mr. Agers. Several succeeding speakers strongly advocated the continuance of the electric light which was highly appreciated by the visitors, and had only cost £600 during the last four years. The point was raised as to whether shareholders in either company ought to vote, and the Mayor replied that he should personally take no part in the proceedings, but other members must do as they pleased. The Town Clerk held that shareholders ought not to vote. Mr. Duke pointed out that, to abandon the electric light, would be to make a retrograde step which ought to be strenuously avoided, considering that they had such a powerful rival in Eastbourne. Eventually the recommendation of the committee was carried by a large majority, the voting being :—For electricity, 10 ; for gas, 4.

**Electric Lighting Tenders.**—The Colwyn Bay and Colwyn Local Board invites tenders for the lighting of the district for three years with either gas, oil, or electric light, the illuminating power of each lamp not to be less than 16 candle-power. The contractor to undertake to do all of the necessary work in connection with the same, such as repairing, cleaning, lighting, &c. Further information may be obtained from the clerk to the board. Tenders to be sent by 9 a.m. on the 18th inst.

**Electric Light at Weston-super-Mare.**—The unanimous expression of opinion of the meeting recently held in favour of introducing the electric light into Weston-super-Mare, has induced initiatory steps for the formation of a local company for supplying the light. It is hoped that Mr. Massingham, of Bath (the originator and managing director of the Taunton Electric Lighting Company), may be induced to accept the position of managing director of the Weston company.

**Electric Lighting at the Dairy Show.**—The Woking Dairy and the stands of Messrs. Freeth and Pocock at the Dairy Show held this week at the Agricultural Hall, were successfully lit by means of incandescent lamps, the installation having been carried out by Mr. W. Habgood, of Dulwich. The light being thrown by means of reflectors on the bright metal work, a very good effect was obtained.

**Something Startling.**—We are promised (says the New York *Electrical Review*) some "startling revelations" in electric lighting shortly, and from a new source.

**Electric Lighting in the City.**—"Dogberry" in the *City Press* says: "The electric light will again shortly be used to illuminate some of the streets of the City, and it is to be hoped the time is not far distant when it will be used all over the one square mile."

**The Paris-Brussels Telephone Line.**—Communication between subscribers to the Brussels telephone system and the line from the local exchange to Paris, *viâ* Quevy, has now been established. The second line to Paris has been erected on Belgian territory as far as Momignies, but the French portion is not yet ready. Telephonic communication is to be opened between Verviers and Aix-la-Chapelle by means of a bronze wire; it is intended to extend this line later on to Frankfort-on-the Main and Brussels.

**Postal Telephonic Charges.**—With reference to our article on the above in our last issue, we are informed that the statement that "In Newcastle and district during the past two years the Post Office has only added eight persons to its list of subscribers" is incorrect, the facts being that, whereas in 1885 the total number of subscribers was 584, in 1887 this number had augmented to 673, an increase of 89 instead of eight only.

**American Telephone Patents.**—The judge of the first circuit in Boston has dismissed the suit brought by the United States Government against the Bell Telephone Company on the ground that the Attorney-General had no authority and no power to bring any such suit. Our correspondence columns contain further information respecting this decision and its probable effect, from the pen of our old correspondent respecting telephone patents, Major W. C. Barney.

**Telephonic Extension in the West.**—On Monday the Western Counties and South Wales Telephone Company opened a new trunk line between Newton and Torquay, in connection with a scheme which is being developed with the view of placing into telephonic communication Penzance and Plymouth, Torquay, Newton, and Exeter, and all the intermediate places. At the opening ceremony several successful experiments were carried out, the instruments used being Bell's receiver and Blake's transmitter. Mr. G. Scott Anderson, district superintendent, expatiated on the large number of exchanges at present worked by the company, and stated that the Torquay exchange had 55 members less than Bournemouth, which was opened nearly a year later. Silicon bronze wire was being used by the company, 3 lbs. per 100 yards, with a breaking strain of 185 lbs., and the whole of the ironwork was so thoroughly tested that accident was out of the question.

**False Economy.**—A proposal was recently made at a meeting of the Alverstoke Local Board to establish telephonic communication between the fire brigade head-quarters and the waterworks pumping station, but it was negatived on the ground of expense. A destructive fire which occurred on Tuesday morning at Gosport serves to demonstrate the extreme unwisdom of this sort of false economy, nearly an hour being lost before there was any supply of water. In the meantime the flames had got a thorough hold of the Star Hotel and Assembly Rooms and the adjacent premises, and were lapping the Roman Catholic Church a door or two off. The church was saved, but the long delay was fatal as regarded the other premises, and they were completely gutted.

**The Antilles Cable.**—It is announced that the Compagnie Française du Telegraphe de Paris à New York is about to create bonds to the amount of 15 or 20 million francs, for the purchase of the concessions for landing the projected cables in the Antilles. The information so far given is so vague that it is not clear whether the cables are to be laid by the syndicate which is being formed by Count D'Ockza and his friends and the system handed over in a complete form to the Compagnie Française, or whether the latter purchases the concessions only and lays the cables itself.

**The Field Motor on New York Elevated Railroads.**—The trials of the Field electric motor on the Thirty-fourth Street branch of the Third Avenue elevated road of New York were resumed towards the end of last month, and resulted very successfully. Twenty-four trips were made by the motor, without any cars being attached, and the speed secured was as great as, if not greater than, that of the locomotives in use upon the road. Power sufficient to draw several loaded cars up the steepest grades of the road was developed. The motor is perfectly free from "sparking," which is overcome by the substitution of a pick-up wheel of copper discs instead of the brushes usually employed. Mr. Field is said to be confident that his motor will be accepted and used by the elevated company, as he can easily demonstrate its advantages over the locomotives.

**The Leamington Gas Dispute.**—An amicable settlement has been effected of the litigation which for the last 12 months has been pending between the Leamington Corporation and the local gas company. The price of gas for the next three years is to be reduced 2d. per 1,000 feet, making it 2s. 6d. to private consumers and 2s. 5d. for public lamps.

**Electric Wire Dangers.**—A New Orleans paper states that several accidents have lately happened in that city to linemen of electric light companies, who have been knocked senseless by coming in contact with wires while in the performance of their duties. One of the accidents about a month ago resulted in death, and on Tuesday, September 20th, a lineman in the employ of the Edison Light Company was knocked from a pole at the corner of two streets by receiving a shock from a wire charged with the alternating high tension current from the Westinghouse machines used by the Brush Electric Light Company. This accident, fortunately, did not prove fatal. Regarding the fatality of a month ago, which also was caused by the Westinghouse alternating current, Mr. Mottram, superintendent of the local Edison Company, gave the following information to a reporter:—"The unfortunate man who was killed was at work on a pole pulling up a dead arc wire, when his foot slipped and he fell across the wires carrying the alternating current, which wires had been bared of insulation in order to tie them in firmly to the insulators. The man was suspended by the wires, and the current passed through his body from the inside of one thigh to the upper ribs on the other side, the flesh being burned to the bone in both places. It was probably five minutes before they could switch off the current from him, and by that time he was stone dead."

**The Telephone in Sussex.**—The telephone exchange at Brighton, to which allusion was made last week, was established by the United Telephone Company in 1882, and was subsequently taken over by the South of England Telephone Company. It now numbers upwards of 760 subscribers. Exchanges are about to be opened in Worthing, Shoreham, and Lewes, and trunk lines will be run to these towns. A trunk line is also being run to Eastbourne, where an exchange already exists.

**A Brave Electrician.**—We are pleased to learn that the Royal Humane Society's medal and certificate have been awarded to Mr. Gilbert C. Pope, of the firm of Laing, Wharton and Down, who displayed great bravery recently at Waterford, in Ireland, saving the life of Mr. D. Keogh from drowning on July 14th, and bringing to shore the dead body of Mr. Baldwin on the 30th of the same month.

**Personal.**—Mr. W. B. Masson (late of the Inverness telegraph office), who for the past 13 years has been in the Japanese Government telegraph service, has been appointed Foreign Secretary to the Engineering Bureau, and Instructor in the Telegraph College, at Tokio, Japan.

**The India-Rubber, Gutta Percha and Telegraph Works Company.**—We have received some well illustrated price lists of electric light, telegraphic, &c., material manufactured by this company. On comparing the prices with those of previously issued lists, we are struck with the great reductions which have been made in the same, this being, in the case of large electric light leads, as much as £100 per mile. In battery stores, also, the prices of some of the forms of Leclanché battery have been reduced as much as 1s. a cell. These reductions have, no doubt, been necessitated by the keenness of competition, which leaves but little profit margin unless by low prices a considerable augmentation on the quantity of businesss done is effected.

**Measuring Coefficient of Self-Induction.**—Prof. S. P. Thompson writes :—"I find that some misapprehension exists (for which I am probably responsible) concerning a method which I suggested some time ago for measuring coefficients of self-induction, and which was a modification of the method of Joubert. I was under the impression that I had stated distinctly that the method was not a sensitive one, and had never in its simple form, given *complete* silence in the telephonic receiver which I used in the bridge. In fact, a little consideration will show that this must be the case if there is a retardation in one arm of the bridge only. To make the method more reliable, it is requisite to add a condenser as a shunt to the opposite arm, or to add a known self-induction to one of the adjacent arms ; this, however, complicates the calculation, the simplicity of which rendered it very convenient for rough determinations. I may add that a differential electro-dynamometer—a species of instrument not hitherto used I think—appears likely to give good results for this class of determinations."

**Melting Copper Wire.**—In reply to the enquiry in our last issue as to the number of ampères required to fuse various gauge wires, a correspondent sends us the following table :—

| B.W.G | Amps. | B.W.G | Amps. |
|---|---|---|---|
| 30 | 21·84 | 36 | 7·72 |
| 32 | 19·25 | 40 | 4·58 |
| 34 | 15·44 | | |

**Electric Locomotion in Brazil.**—Mr. Wharton, of Philadelphia, states that the Emperor of Brazil has sent an order for a special palace car for his own private use, to run upon the street railway lines of Rio de Janeiro, and that it was understood that the car was to be run by Sprague motors, driven by the storage batteries of the Electrical Accumulator Company. He said that it was a curious commentary on the widespread knowledge of the present day that the first electrical storage car of this system in practical service would run upon the tracks of a street railway in South America.—*Street Railway Gazette.*

**Society of Telegraph Engineers and Electricians.**—The first meeting of the Society's winter session will be held on November 10th, when the following paper will be read :—"On Deep Sea Sounding in connection with Submarine Telegraphy," by Edward Stallibrass, F.R.G.S., Member.

**Telegraphists' School of Science.**—The staff of this school has good reason to be satisfied with the results of the past session's work. In the telegraphy examination, under the City and Guilds of London Institute, held last May, the school was the most successful in the kingdom. In all 73 certificates were awarded, and 13 of them were taken by Mr. Slingo's students, 10 being first class. The first prize (£5 and silver medal) was gained by Mr. F. Tandy, and other students secured three out of 12 first class honours certificates, and seven out of 36 first class ordinary certificates.

**The Chinese Telephone Concession.**—Speaking of the "concessions" obtained by Count Mitkiewicz and his American syndicate from the Chinese Government, a correspondent of the *Times* says :—"It will hardly be credited, after all the noise on the subject, that the Count has got what is not worth having, and what the Chinese had no power to give, and that he has paid—or rather promised to pay—a very high price for it." The correspondent proceeds to give facts in support of this statement, an important one being that "the Chinese can prevent no one from setting up any telephone he likes, nor can they authorise anyone to set it up, for they gave up their authority over these places [the treaty ports] by treaty so completely that it is doubtful whether they could carry a telegraph line across one of the settlements themselves without the consent of the Consuls, or of the municipal authority, if there is one."

**Protection from Electric Wires.**—The Chicago correspondent of the *Electrical Review* of New York recently wrote :—"Prof. J. P. Barrett left yesterday for Atlanta, Ga., to attend the yearly gathering of the chiefs of the Fire Departments, or more explicitly, the National Association of Fire Engineers, with a paper in his pocket which he will read to the association, and a little model under his arm to show the association. The first will interest the chiefs, because it talks in a very practical way of how to protect persons and property from electric wires, and the model has the same end in view. The invention is the professor's own, and it shows the unselfishness of the man, in this, that it is intended solely for places where wires cannot in the natural course of things be placed anywhere but overhead. It is not needed here. The model shows a ladder, on the one face of which a strip of metal runs the whole length of each standard, or side-piece, and terminates in a metal shoe at the foot of the ladder, on either side. A cross connection is also made from one of these to the other, and attached to the side of the ladder a pair of adjustable wire cutters can be placed at any distance from the bottom. Of course the use of such a ladder is apparent at sight. It is raised against a wire, the two metallic faces rest upon it. Standing on the ladder, the fireman may cut the wire with impunity, the extra current from the magnets discharging through the cross connection between the uprights, or, if the line is heavily grounded, the discharge may take place to earth ; or it may divide between the two routes."

**Heating of Magnets.**—"Volt," writing to the *Engineer*, says :—"I have read with much interest the description of Edison's new generator which appeared in your last impression. Permit me now to suggest that a very careful investigation shall be made as to the specific heat of magnets. It is quite clear that if the theory of the conservation of energy is true, work must be done every time a magnet is demagnetised by heating it. If this be the case, then more heat must be expended in raising a magnet to a given temperature than would be needed to heat a similar non-magnetised bar through the same range. May I venture to suggest that such an inquiry as this could be admirably carried out by Mr. Hughes."

**Electricity in the Royal Navy.**—The new torpedo gun-boat, *Sandfly*, which was recently launched at Devonport, is to be provided with a very powerful search light. She is to cost £36,000 when completed.

**New Publication.**—We have received a specimen sheet of a small book, entitled "The Morse Signaller's Companion," compiled by Mr. Streatfield James, Assistant-Superintendent in the Indian Telegraph Department, for the special use of the class of signallers employed in railway and postal combined offices in India. The book contains 12 coloured plates and about 24 woodcuts. It is divided into 13 sections, dealing with: "Definitions;" "The Minotto cell and construction of batteries;" "Explanation of circuits;" "Method of producing signals;" "Signalling keys: how used with open and closed circuits;" "The lightning discharger: its construction and place in circuit;" "Magnets: their nature and properties;" "Sounders: different patterns in use, their construction and application;" "Manner of connecting lines and instruments in open and closed circuit;" "Bells: how, when and where used;" "Local circuits;" "Complete connections of a terminal and of an intermediate office in open and closed circuit;" "Morse signals explained. General rules and adjustments." The various sections give simple and brief explanations of the subjects dealt with. The book seems well adapted for the purpose intended.

**Removal.**—Messrs. Howard and Haig's new address is 11, Charterhouse Buildings, Aldersgate, E.C.

## NEW COMPANIES REGISTERED.

**Colville Company, Limited.**—Capital: £6,000 in £1 shares. Objects: To obtain and enter into concessions for public works, including railways, tramways, land and sea telegraphs and telephones, electric light and power, and also to carry on the business of a mining, smelting, and trading company. Signatories (with one share each): H. R. Lewis, M.E., and C. F. Roseby, M.E., Bartholomew House, Bank; W. Beckett, 3, Duke Street, Adelphi; N. S. Wellbourne, 15, Vicarage Road, Camberwell; J. Thomas, 2, Portsea Place, Connaught Square; C. A. Coles, 37, Walbrook; Wm. Taylor, 2, Eunice Road, Chiswick. The signatories are to appoint the first directors. Qualification: 50 shares. Remuneration: £100 per annum to the chairman, and £75 per annum to each other director. Registered 5th inst. by Snell, Son and Glenip, 1, George Street, Mansion House.

**Whitehall Electric Supply Company, Limited.**—Capital: £200,000 in £5 shares. Objects: The production, transmission, storage, use, supply, and sale of electricity for lighting, motive, and other purposes. Signatories: Major J. T. Wright, R.E., 12, Cadogan Terrace, N.W.; G. Dibley, Coventry Park, Streatham; J. Gutteridge, J.P., 14, Tufnell Park, N.; J. W. Hobbs, Norbury Hall, Streatham; L. B. Burns, Winchester House, Old Broad Street; H. G. Wright, Bletchley; J. S. Balfour, J.P., Wellesley House, Croydon, 200 shares each; J. E. H. Gordon (electrical engineer), 28, Callingham Place, S.W., 50 shares. Directors' qualification: 50 ordinary shares. The subscribers are to nominate the first directors. Remuneration: £1,000 per annum. Registered 5th inst. by Bircham & Co., 46, Parliament Street. Office: Savoy Hill House, Savoy Place, Strand.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Swan's Electric Light Company, Limited.** — The annual return of this company made up to May 16th was filed on the 8th inst. The nominal capital is £100,000 in £10 shares, the whole of which are taken up. 2,500 of these shares were allotted to Mr. Joseph Wilson Swan as fully paid. £5 per share has been called and paid upon the remaining shares, the total of the calls paid amounting to £37,500.

**Electric Medical Appliance and Truss Company, Limited.**—The seven subscribers to this company have applied to the Registrar of Joint Stock Companies requesting him to exercise the powers conferred upon him by the Companies Act, 1880, with a view to striking the company off the register, the company not having carried on business since its incorporation, and not being likely to do so.

**Cadogan Electric Light Company, Limited.**—At an extraordinary general meeting of the shareholders in this company, held at 137, Regent Street, on the 1st ult., it was resolved that 3,000 fully paid shares of £5 each, be issued by the company and held by the directors to give, sell, or pay the same by way of bonus, reward, or commission, for obtaining subscription shares of the company, or otherwise for the benefit of the company as the directors shall think fit; such shares to be called "B" shares, and not to be entitled to dividend until the ordinary shares have received a dividend of 5 per cent. per annum, after which the balance of profits will be divided equally between the "A" and "B" shareholders. These resolutions were confirmed on the 16th ult., and duly registered on the 5th inst. The capital of the company is thus increased £15,000 beyond the registered capital of £30,000.

**Manchester and District Edison Electric Light Company, Limited.**—The office of this company is now situated at 14, St. Ann's Square, Manchester.

## CITY NOTES.

**The Electro-Metal Extracting, Refining and Plating Company, Limited.**—We are requested to notify that the patent processes of this company for recovering tin and other valuable metals from waste materials having proved successful, the company has agreed to sell its works and business to a new company to be registered with a capital of £150,000 in £1 shares, capable of largely extending the operations in London as well as by the erection of five other works in the large manufacturing centres. The shareholders of the company have all agreed to accept fully paid shares in the extended Electro-Metal Extracting, Refining and Plating Company, Limited, and in many cases to largely increase their holding. The balance of capital not privately subscribed will be offered to the public shortly in the usual way. The old company will be voluntarily liquidated.

**Brazilian Submarine Telegraph Company, Limited.**—The accounts of this company, subject to audit, show a profit sufficient to enable the directors to recommend a final dividend of 3s. per share, making with previous distributions a total dividend of 6 per cent. for the year ended June 30th, 1887, and also the payment of a bonus at 2s. per share, both free of income tax, which together will amount to £32,500, being a distribution in the aggregate of 7 per cent. for the past year, leaving a balance of £26,932, of which amount £25,000 has been placed to the reserve fund, increasing that fund to £112,700 and £1,932 carried forward. The above dividend and bonus will be payable on November 30th.

**The Globe Telegraph and Trust Company, Limited.**—The directors have declared the payment of an interim dividend on and after the 21st inst. of 3s. per share on the preference shares, less income tax, and of 6d. per share on the ordinary shares, income tax having already been deducted, for the quarter ending October 18th. The transfer books were ordered to be closed from the 14th to the 21st inst., both days inclusive.

**The Western and Brazilian Telegraph Company, Limited.**—The directors have declared an interim dividend of 3s. 9d. per share, free of income tax, for the half year ended 30th June last, being at the rate of 2½ per cent. per annum upon the ordinary shares and 5 per cent. per annum on the preferred ordinary shares, payable on the 15th inst.

**Reuter's Telegram Company, Limited.**—The directors have declared an interim dividend at the rate of 5 per cent. per annum, tax free, for the half-year ending June 30th, payable on the 15th inst.

### TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 7th were £3,249, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended October 7th amounted to £3,966.

## CORRESPONDENCE.

### Insulation of Underground Wires.

I noticed in your issue of September 30th ult. the extremely interesting remarks of your correspondent, "F. I. C., F. C. S." with reference to my letter of the 9th September upon the insulation of underground wires.

I am afraid that on certain points he has misunderstood me, but I hope that the following reply to his communication will dispel such misconception as may have arisen.

My argument was, and is, that upon any accident occurring to the lead coverings, the cotton coated or saturated with the composition would be found, as compared with a covering of India-rubber, an inefficient insulation. As to the remainder of the paragraph, I do not suppose that your correspondent really means that a lead pipe is a sufficient insulator even when coated with pitch, without some inner insulating material between the conductor and the lead. If the "layers of lead and pitch do form" an efficient outer insulating covering, why employ the saturated cotton at all? If the saturated cotton will not absorb moisture where unprotected, why cut off the ends of the cable? Your correspondent has here missed, or misinterpreted, the point I aimed at.

It is to be remarked that two coverings of lead and two coats of insulating compound are at present employed in the manufacture of the Berthoud-Borel cables. I have every reason to believe that the second coverings of lead and insulating composition were necessitated by the extreme porosity of the lead when only one covering was used. It logically follows that these second coats can only diminish and not eliminate the weakness of the system while rendering the cable less convenient to handle. Should better insulation be required, I would suggest the application of three or more coverings of lead and composition, increasing the number of these as the case may require.

As to the oxidising of linseed oil in a special manner with resin, I entirely agree with "F.I.C., F.C.S.," but I would point out to him that my letter shows this statement, as well as the one referring to the use of cotton or "hemp," to have been taken from an apparently authoritative article written by Mons. A. Palaz in *La Lumière Electrique*, of August 20th ult., consequently the description is not mine.

Beyond the very apparent difficulties of making a compound at a high temperature, which should have the necessary consistency at normal temperatures and of thoroughly saturating the fibrous material employed, I can distinctly see great difficulty in *hermetically* sealing the cable in the manner "F.I.C., F.C.S." states is actually practised. His analogy of varnish in a bottle is very apt, but my argument is that there exists a hole in the cork.

I am much obliged to your correspondent for pointing out that a liquid containing a solid *dissolved* in it of a different specific gravity does not allow of the separation of that solid according to its specific gravity, but I do not see that this statement holds good with regard to a mixture, a condition implied by my letter. The employment of resin and linseed oil may take in practice, as your correspondent must be aware, the form of a saturated or over-saturated solution, when the solvent action of the oil is not sufficient to overcome the excess of resin. Should your correspondent look at the matter in this light he may to some extent agree with my argument.

I fail to perceive the application of your correspondent's remarks upon the heat resisting quality of the composition; this, as he says, depends upon its melting point, which I presume will be more or less high according to the component parts of the mixture. A similar statement can be made with regard to almost any composition.

With respect to his theory that the composition has an advantage over India-rubber when exposed to the action of heat such as would be engendered by molten lead, I can inform your correspondent that actual experience has conclusively shown that vulcanised India-rubber (a "good admixture") can be coated with molten lead without suffering any deterioration except superficially and to a slight degree. I consequently do not see what advantage the composition advocated by "F.I.C, F.C.S." possesses in this particular instance.

Your correspondent, in giving the melting points of India-rubber and gutta-percha, probably refers to these materials when unvulcanised and not in the presence of sulphur; his remarks, therefore, require considerable qualification. Perhaps he is unaware that India-rubber covered leads are generally vulcanised. His views on the subject may be interesting from certain points of view, but are somewhat misleading, as the following figures, with which I have been furnished, prove:—Unvulcanised India-rubber at a temperature of 115° C., softens; unvulcanised India-rubber at a temperature of 148° C., softens and becomes sticky; unvulcanised India-rubber at a temperature of 192° C., commences to run at the edges; unvulcanised India-rubber at a temperature of 203° C., decidedly melts; vulcanised India-rubber at a temperature of 260° C., does not melt. Now 260° C. is higher than the temperature of lead when applied during the covering of cables as in the Berthoud-Borel system.

Your correspondent asks me for proof of my statement that high temperatures injuriously affect cotton and other fibrous tissues. For information on this point I would refer him to Mr. W. T. Suffolk, F.R.M.S., who in "Microscopical Examination" states that fibrous tissues will not bear a heat exceeding that of boiling water without injury, and it cannot be denied that this injury must be magnified in the presence of fatty acids.

It is extremely interesting to learn, on the authority of "F.I.C., F.C.S.," that resin possesses the quality of neutralising fatty acids, as up to the present I have always believed that, on the contrary, resin dissolved in oils accentuates their acidity.

Although I thought that the deterioration of cotton when exposed to high temperatures was a well known fact, yet in view of the very strong opinion expressed by your correspondent, my confidence as to the correctness of my information was somewhat shaken, the more so as from the signature of "F.I.C., F.C.S." I concluded he wrote with considerable authority on the subject. In order, therefore, to satisfy myself upon the question, a large number of experiments were carried out at my request, and the following are the average results obtained from steeping cotton fabrics in a compound of resin and linseed oil at various temperatures:—

Previous to immersion at normal temperature, equal breaking strain, 1,452 grammes; after three hours immersion at 99° to 105° C. temperature, equal breaking strain, 560 grammes; after one hour's immersion at 260° C. temperature, equal breaking strain, 140 to 145 grammes; after four hours immersion at 260° C. temperature, equal breaking strain, 45 to 50 grammes.

As was to be expected, an acid reaction was observed in the mixture at all temperatures, and in a proportionately greater degree as the temperature was raised.

I am perfectly aware that the presence of air would increase the prejudicial action on cotton or other materials, but I maintain that such action exists whether air is present or not, and I think your correspondent reluctantly admits this when he says "The cotton being heated in the composition *without access of air* is capable of standing a high temperature without injury *better* than it would if air were present."

As to the durability of lead, your correpondent is correct up to a certain point, as it is a well-known fact that lead is less susceptible to the action of acids than most other metals. It is, however, prejudicially affected under certain circumstances, as witness the case of the Japanese lighthouse illumination, where it was found that the oil kept in lead tanks had assimilated a sufficient quantity of the metal to seriously interfere with the illuminating qualities of the oil, and, in fact, to such an extent, that globules of lead were discovered in the wicks, attention being thus called to

the matter and resulting in a chemical analysis of the oil. I do not for a moment wish to contend that lead is absolutely bad, but the reference to isolated lengths of lead piping being found in good condition at Pompeii and in many other Roman remains on the Continent, is of little or no value, as it immediately suggests the absence of the remaining portions of the piping, the preservation of the lead depending entirely on the composition of the soil surrounding it.

In considering the action of linseed oil your correspondent appears to admit, but not to the same extent as I believe in, that oils act prejudicially on metals, linseed oil being one of the most destructive. Mr. W. H. Watson, a well-known authority, says that the corrosive action of linseed oil upon copper is greater than that of any other oil. This fact is interesting, as conductors are generally made of copper, but the effect produced on the insulating material by the reaction is too complex a question for me to discuss at present.

The fact remains that linseed oil acts destructively on metals, and, therefore, its employment is undesirable. I must admit that the extent of the action depends on the quality of the oil used.

With regard to common resin, I understand that pinic and sylvic acids possess as strongly marked acid properties as acetic acid.

As to the lead-covered cables being "less clumsy to handle than others," such a statement, coupled with some of your correspondent's remarks upon insulation, would lead me to suppose that however valuable his chemical opinion may be, the practical application of electricity and the handling of cables are matters scarcely within his province.

I am pleased to hear of the success attending the Berthoud-Borel system in Greenock, which contrasts favourably with the experience of the "Sociedad Matritense" in Madrid, where, I understand, the whole of the Berthoud-Borel system utterly failed, and had to be removed.

Your correspondent's strong point appears to be the claim that the process he defends effectually excludes air during manufacture, but this I think his letter scarcely proves. The other considerations are really of minor importance, although they have led to this lengthy reply.

W.

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In reply to the letter of Mr. T. O. Callender which appeared in your issue of September 30th, and where he asks in what city the experience of his system does not lead me to place much faith on his method of insulating and protecting underground wires, I may state that the city I referred to is Antwerp. Here, I learn, the Callender underground system has been condemned, through having failed to give satisfaction.

Mr. Callender states that his company has made nearly all the underground mains in use up to the present time for public or private lighting, and he says he can give hundreds of instances where his cables have been so employed with perfect success. Mr. Callender, as manager of the company, must be in the possession of all the data necessary to enlighten us in greater detail as to the lengths of his system now in use, and the localities where his cables are placed. Particulars of this nature are of far greater value than general statements, and I am only asking for information which Mr. Callender in his letter offered to supply.

With regard to the United States, Mr. Callender says that the systems there employed are essentially bituminous. In support of my argument that in America these underground systems have given a great deal of trouble, I would call Mr. Callender's attention to the report of the last meeting of the American National Electric Light Association, at which delegates from various towns were almost unanimous in condemning the systems at present in use, and it appeared from the statements made that in many cases underground work was absolutely at a standstill owing to the several companies being unable to decide upon some trustworthy type of cable.

As to the Edison tubes referred to by Mr. Callender, I remember that some three or four years ago the failure of this system in New York City caused considerable inconvenience. I must admit, however, that I do not exactly know what improvements have been made in this type since that date.

W.

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### The Causes of Unsteadiness in Arc Lamps.

Luckless, indeed, was Mr. Lever in not having been born a citizen of Lutetia, and more unfortunate still those amiable amateur lunatics, "*les Incoherents*," who have thus lost one who would have made, if diction is an index of the cerebral state, so promising a member of their eccentric circle. Perhaps, had the soul (excuse the poetic fiction) now inhabiting Mr. Charles Lever's earthly clay chosen instead (according to the Hindû and Pythagorean notions) a Parisian carcase as its next resting-place on the road to the Nirvana, the carcase thus animated might have risen to the leadership of that charming tribe, and by his, or her, or its superior genius saved so delightful an idea from an untimely *décadence*. Excuse this retrospective and visionary reflection inspired by the perusal of the communication which is supposed to constitute a reply to my letter of the 30th ult.

It appears that the style of the epistle in question is "laboured." How truly delicious it is to behold Mr. Lever posing as a critic of English prose style! Evidently my adversary has the fullest right to despise those who take the trouble to render their effusions intelligible, since he has ever shown himself so vastly superior to such vanities and weaknesses. After having solemnly enunciated this opinion, my courteous assailant proceeds to misquote me, doubtless with the laudable intention of disproving my assertion that careful reading of the writings he seeks to demolish is the least of that gentleman's cares. I must, however, admit that my best apology is due to the readers of the ELECTRICAL REVIEW for having inadvertently cited *almost* as an "authority" a journalist who, as Mr. Lever informs me, has spoken in "eulogistic terms of the Leverian system."

Although accusing me of a tendency to "jump to conclusions," my critic performs that athletic exercise with infinitely startling effect. I should fancy that Mr. Lever was sole amongst your readers to imagine that "the most puffed and most talked about of arc systems" referred to, was that of my most amiable opponent. No jealous feeling could possibly have dictated the passage in question for the simple reason that it does not allude to the offspring of Mr. Lever, a fact sufficiently obvious since evidently it would have been not a little absurd had I referred to the lamp under discussion as being the "most talked about of arc systems." Nor has the success of Mr. Lever's invention attained proportions capable of troubling the "night-time visions" of the "would-be inventor." For most electricians the allusion was manifest enough, I feel convinced; but it seems that for Mr. Charles Lever "*il faut mettre les points sur les i.*"

Having commenced to "jump to conclusions," Mr. Lever, wishing to continue the pastime, pretends that I referred to his lamp in my remarks on dash-pot worship, although it is, I think, tolerably clear that I wrote of this device in a general sense, without any allusion to a particular system. Nevertheless, I do not see why Mr. Lever should become so indignant at the mere mention of a "dash-pot," since, if my memory be not altogether at fault, the original Lever lamp comprised some such contrivance. Not having seen a lamp of Mr. Lever's type for some time, I had a right to infer, from that gentleman's praise of the short arc, that his regulators were worked on that system. On reading the statement that this is not the case, one is inclined to ask for what reason, since the short arc possesses so many "advantages," &c.

I am told that I know very little of the Leverian system. Evidently a proof of most consummate ignor-

ance on my part, at least in Mr. Lever's eyes! For my part, I imagine that even had I supposed the lamp in question to have undergone no change since 1882, I could hardly have been blamed. Considering the shortness of life, one cannot well be expected to be completely *au courant* of all the infinitesimal alterations, otherwise called "improvements," of old devices which are daily produced and dignified by the name of "inventions."

Mr. Lever is evidently quite horrified at the simple abstract mention of offensive weapons, and seems to hint that the mere knowledge of the use of such shocking things as rapiers and "six-shooters" is enough to deprive me of all authority on things electrical. How comes it that Mr. Lever, who has, I believe, visited "the States," makes it appear as though the "rifled pistol" and "triple-edged rapier" were in use for "wiping out" purposes in those delectable regions? I admit myself much charmed by the idea of becoming a Western editor, and it is quite probable that I may follow the advice of my antagonist when in need of "fresh excitement," with the meritorious object of perfecting my revolver practice. Should I do so, I will endeavour at any price to induce Mr. Charles Lever to take charge of the "oblique puff" department, and give occasional attention to the paragraphs of unsophisticated Billingsgate. It would be formally stipulated that access to my colleague's office could only be obtained by first passing through my own. I will moreover agree, in case of "accident," to pay a considerable indemnity, and to offer £1,000 each to the authors of the most complete essays on "The Average Longevity of Western Journalists" and on "The Physiology of Pantaloons."

Desiring once more to pose as a literary critic, Mr. Lever expresses the opinion that I am a writer of "slosh." As I have never before come across this slang term, I am not sure how it ought to be translated into civilised English. I would, however, much like to know what adequate term could be applied to the incoherent mass of clumsily jerked-out phrases which, according to Mr. Lever's ideas, constitutes a literary production.

My blissful ignorance, as regards the brilliant point made by my adversary in commencing his letter, was not *quite* so complete as the individual in question seems to imagine. But since such a remark was obviously worthy of the most consummate *crétin*, I hesitated to consider my would-be critic as such without more conclusive evidence. This Mr. Lever, with his customary politeness supplies, with the result that I am in my turn amused on seeing that I am considered by him to be a disappointed arc lamp inventor, who "goes for" solid carbons because they will not burn in his lamp, and falls foul of the ring-clutch systems for the reason that they are cheaper than his own; or, in other words, Mr. Lever supposes me to be actuated by personal motives, as most evidently are his own critical efforts! This veiled accusation is merely worthy of contempt; my sole reply is to inform that gentleman that should I ever exploit an arc lamp in England I will advertise it in the *advertisement* columns of the REVIEW.

The immense humour which underlies the notion of citing Messrs. Laing, Wharton and Down, and the too-celebrated Brush Company as authorities on Yankee carbons, will doubtless be appreciated by your readers. I imagine that the first-mentioned firm would emit the opinion that the "Brush" carbons are "trash," and that the Corporation would return the compliment!

No tests having been made, the question of the relative brilliancy of the light with cored or solid carbons, remains precisely where it was at the outset. The question of cost has been dragged into the controversy by Mr. Lever, and has nothing to do with the facts advanced by myself. I leave that gentleman to "fight it out" with the carbon makers. Let the "gratis advertisement" seekers demolish each other; I retire from the discussion.

The concluding paragraph of Mr. Lever's letter commences by an insinuation which is best answered by silence. I do not see how the case of the ring-clutch lamps is in any way bettered by the remarks of Mr. Swinburne, since, if all the conditions laid down by that gentleman are observed, what becomes of the much-vaunted "simplicity and reliability" of the system?

The assertion that I am "driving at" something because I expressed a somewhat favourable opinion on the regulating shunt solenoid and arc striking magnet combination, would be insulting were it not so manifestly absurd. Obviously, no one could have any interest to speak favourably of a disposition of parts which is, and always has been, as truly public property as is the principle of Mr. Charles Lever's miraculous arc lamp. When writing on the arrangement in question, I at least took the trouble of enumerating the advantages and defects of the method. It will be noticed that my opponent adopts the more simple course of condemning it without giving his reasons for so doing.

A few words will suffice to dispose of the letter of Mr. FitzGerald. That gentleman in beginning by the assertion that I have attributed the unsteadiness of arc lamps to the carbons used, shows that he has not read my letter with any great attention. It is perfectly true that I have mentioned the impurities of the carbon as being one of the many causes of unsteadiness, but I never enunciated the opinion which Mr. FitzGerald seeks to attribute to me.

The invitation to cross the Channel for the purpose of staring at certain lamps in action at Bishopsgate Street Station is somewhat more than droll. When I next visit the English shores I hope to make the voyage in a balloon or by train (through "the tunnel"), but I promise Mr. FitzGerald that if at that far-off period the six simplex regulators have not passed from amongst the things that be, I will make a special journey to Bishopsgate Street to be astonished by the performance.

I confess that the lamp mentioned by Mr. FitzGerald is unknown to me unless it be the "Simplex" (J. D. R. Mackenzie's patent*), which was exhibited at the Westminster Aquarium in 1883. I recollect that this regulator worked very ill indeed, but perhaps that referred to by Mr. Fitzgerald resembles this "Simplex" in name alone.

On glancing over that which I have written I ask myself whether it was veritably necessary to reply to all the puerile abuse and baseless insinuations and suppositions of Mr. Charles Lever. If that amiable person chooses to believe that his lamp is superior to all that has yet been evolved from human brain, why should I waste my time in trying to prove the contrary? No serious arguments, no tenable objections have been advanced by my opponent. Not a sentence written by me has been refuted. As for the abuse *a jet continu* which Mr. Lever pours forth in his last week's letter, in no way does it affect me, since it is utterly meaningless and absurd.

*Apropos* of abuse, I must admit that I have been rather severe, but,

"*Im Deutschen lügt man, wen man bröflich ist.*"

After all it is strange that the discussion should have assumed such proportions since, as will be remembered, I never denied that solid carbons of good quality would work *more or less* well; indeed I have myself produced a light, steady enough for some purposes, from these electrodes on more than one occasion; but to approach the ideal, the "absolute" fixity, either a wonderful purity of the carbon or a "core" become necessary.

To continue this sterile controversy would be absurd. Mud-throwing is not scientific discussion. I therefore inform Mr. Lever that should he think by some extra abuse to goad me into continuing a dispute which will then have become a veritable gutter warfare, his attempt will not be attended with success.

Should any clutch-lamp inventors in search of publicity now desire to attack me they may at present

* No. 4,046, 1882 (?)

"come on." I will allow them to howl on undisturbed.

The motives of my critic were so manifest that I regret that I did not reply, saving thus an immensity of inkshed, simply in those words of Molière, which have become proverbial :—"*Vous êtes orfévre Monsieur Josse.*"

**F. de Wolffers.**

Paris.

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There was a printer's error in my letter on the above subject in your last issue, which appeared to make my argument, in regard to the price of carbons, somewhat absurd. The sentence I refer to should have read thus : "Freights are low and these could be delivered here at about ¾d. (three farthings) per foot."

**Charles Lever.**

[This correspondence must now cease.—EDS. ELEC. REV.]

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### Pure Water Primary Batteries.

My attention has been drawn to a very lively discussion going on in your country in relation to the novelty and merits of the so-called "Water Primary Battery." On page 250 of the current volume of your journal you state that one of your correspondents holds "that the action and use of simple plain water in the outer cell is a conspicuous novelty." I do not know whether he will continue to think so after he has consulted a French patent granted March 1st, 1865, to the Baron Zawliski then residing at 21, Rue Notre Dame des Champs, Paris. This patent, No. 66,435, relates to a galvanic battery in which a carbon electrode is immersed in a porous cup containing nitric and sulphuric acids, and a zinc electrode is immersed in an outer vessel containing *pure water*. I understand that iron is the positive element in the battery put on the market by the "Water Primary Battery Company." This may be a novel feature in connection with a depolarising liquid containing a carbon electrode. It is, however, not new to generate an electric current by pure water brought in contact with iron. See for this feature *Poggendorf's Annalen*, Vol. 107, p. 1, where Quincke sets forth that pure water forced through iron will generate an electric current.

**A. M. Tanner.**

Washington, *September 27th*, 1887.

MEM.—The above reference to a French patent was obtained from the printed volume of patents which simply contains a title entry, stating use of pure water, &c., as I have given it. It is possible that the full specification may describe other metals than zinc. This information, however, can only be obtained by consulting the patent at Paris.

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### Transformers.

In reply to Mr. Rankin Kennedy's letter, in which he enumerates the disadvantages he sees in the use of continuous current transformers, he leaves the impression that because Messrs. Cabanellas, Edison, and Déri have not succeeded, success is impossible. No progress would be possible if every one condemned a system because one man, or even two or three, have not been successful.

We claim more especially as an enormous advantage the possibility of utilising the same mains for transmitting power, which will prove of even greater value than lighting only. It is not intended that these transformers should be placed in each house to be lighted, but that they shall be of such capacity as to supply a number of offices, shops, warehouses, or dwellings. In an alternating system of transformers the plant is during the summer months twenty out of twenty-four hours idle, which means a great loss.

**Paris and Scott.**

*October 11th*, 1887.

While the subject of the invention of the systems of distribution by transformers is under discussion—and there appear to be a good many claimants for the honours due to those who have really made substantial advances in the art—I may be allowed to give here a few of the leading dates of what appear to me to be the most important advances made :—

1835. Faraday invented the induction coil, open and closed magnetic circuit.
1856. Cromwell Fleetwood Varley perfected the closed magnetic circuit transformer, making the iron enclose the conductors, and thoroughly laminating the iron. Patent No. 3,059.
1857. C. W. Harrison proposed to use induction coils. In a patent granted to him, he proposes to use a primary circuit to supply the coils, and to work lamps from the secondary circuit.
1877. M. P. Jablochkoff patented the use of induction coils in a primary circuit containing the coils in series order, and working lamps from the secondary circuit.
1883. Mr. Rankin Kennedy, of Glasgow, in the ELECTRICAL REVIEW of London, pointed out the cause of the failures with coils in series order, and stated that if placed in parallel order they become self-regulating.
1885. Messrs. Zipernowski & Deri patented the use of coils in parallel order.

These dates have been mentioned by Kennedy, in his pamphlet, and by others, as the leading ones, and if correct would seem to support his view that no "master patent" exists on the subject.

**Robert Mitchell.**

Glasgow, *October 6th*, 1887.

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### Telephones.

Want of time hindered me from continuing my letter in your REVIEW of 30th ultimo. I can now, however, do so, though hurriedly.

Mr. Barney next says : "The English Mechanic Receiver I knew well, years ago, was published in August, 1876, but I am correct in my statement that the membrane telephone with the small piece of iron attached to its centre, was first mentioned by Bell before the Society of Telegraph-Engineers, October, 1877."

Now, Sirs, I had pointed out that this was not so, but that the E.M.T. had been first mentioned by Bell, at the Massachusetts Institute of Technology, U.S., in 1876. Mr. Barney then goes on to say "that he *meant* to assert the fact that that was the *first* time Bell himself spoke of such an instrument in *England*."

Well, now, I am also quite agreed there ; but Mr. Barney must forgive me for not knowing what he *meant to assert*, particularly as there was no context to go by. Webster's definition of a membrane is very similar to that of Dr. Ogilvie's. But I fail to see how mica, vulcanite, or ferrotype, come within touch of Ogilvie's definition. Vulcanite might, but how can mica, or iron, be made to do so ?

With regard to the Glasgow receiver, with a *thick* iron disc, I do not for one moment deny (and have never done so), that such an instrument speaks clearly. Although I have not tried *this kind* of Glasgow receiver, yet if asked what it would be like, I should have said, judging from other experiments in telephony, that it would be *clear ; very low ;* and the pitch of the voice *high*. Apart from the thickness of the iron, the articulation would be low, from the fact of the disc having an air escape at its periphery. But I cannot help doubting that such an instrument would come within the pale of the true Glasgow receiver. The Glasgow receiver, it is well known, had a diaphragm of iron about the *thickness of cartridge paper*, fixed down at one point and slightly tipped up. A

thought is sufficient to perceive what a useless piece of apparatus this would be for transmitting and receiving speech. It would give out a booming noise, and instead of tympanic vibration, move backwards and forwards in a lumbersome fashion.

In the Appeal in the "Harrison Cox-Walker" case the judges tried to hear with the Glasgow receiver speech being transmitted from a Bell receiver. Their lordships heard *faint sounds* and *rumblings* (what I have heard myself), though once Lord Justice Bowen *managed* to make out some words. Now, one knows how easy it is to hear with two Bell receivers; but after the above, imagine the absurdity of trying to transmit and receive speech with two Glasgow receivers.

Now, Sirs, knowing what the Glasgow receivers are, compare them with Mr. B's. (so-called) Glasgow receivers. Mr. Barney is right, Bell has no specified claim for tympanic vibration. But, notwithstanding, I cannot help thinking that if anyone used a ferrotype diaphragm, and tympanic vibration clearly occurred, on the strength of Bell's claim that diaphragm, in the event of a law action, would stand a good chance of being squashed—equal fighting men on both sides being, of course, assumed. It is out of the question, therefore, to be cocksure that the receiver Mr. Barney mentions would be a *true Glasgow receiver*, and therefore "legally" as well as "morally free."

I once thought myself, of selling a telephone to be made in the following way, but didn't, because it was such an open question if it were really a Glasgow receiver. The diaphragm where it was to be attached to the telephone case was to be of thick iron, so that it could neither *give* or *vibrate* at that point. It (the diaphragm) was then from this point to gradually shave off to a suitable thickness for tympanic vibration. Another, better, suggestion—my partner's—was to take a round piece of iron of a good thickness, and from it turn out a circular hollow, leaving sufficient metal for tympanic vibration. There would thus be around the circumference of this *thin* surface of metal a *thick* collar of iron. Then all that remained was to simply attach this diaphragm to the telephone case with *one* strong screw, which passed through the thick iron collar.

Such diaphragms as these would be similar in principle to the one Mr. Barney has used except that they would give *far better results*, and would be of commercial utility, whereas Mr. Barney's would speak too low for that. But would they be Glasgow receivers? That is the question. If the diaphraghm Mr. Barney mentions is, then assuredly these are too. But I doubt it. But if this diaphragm of Mr. Barney's be "legally and morally" free how comes it not to be seen in use anywhere; is it because is speaks too low?

I don't quite infer Mr. Barney's meaning when he says that Sir George Jessel held the Glasgow receiver to be an anticipation of Bell's receiver. Surely Mr. Barney cannot blame me for defending myself? "Puzzled" originally asked for some information. I answered. Mr. Barney followed with a supplement and unwittingly misrepresented me in one of my statements. Did Mr. Barney expect that I was not to reply to that?

Mr. Barney ends up his last letter by saying:—"I do not wish to enter into any controversy with anyone, but when I make a statement which I know of my own knowledge to be true, I think it uncourteous to deny the truth of my statements without having tested the fact, and merely upon an hypothesis."

Allusion is partly made here to Mr. Barney's Glasgow receiver. Now, although I repeat that such an instrument would speak low (which Mr. Barney admits himself), wherein have I denied *the truth* of his statements in connection with *that kind* of Glasgow receiver, I should like to know? Please do not be so precipitate, Mr. Barney. And as regards "discourtesy." Really Mr. Barney this is too unkind of you. In discussions, if a statement by an opponent is *in good faith* denied, called in question, or corrected, it is not by any means looked upon in such a one-sided light, or considered as discourtesy to do so, at least not here. Some of my statements may, no doubt, be wrong; and, when shown to be, will at once be admitted, but such a thought as your being uncourteous for correcting me will never enter my head. On the contrary, I shall feel only too pleased to obtain useful instruction.

In conclusion, I should like to ask Mr. Barney whether it is not a little sad to see his letter on the Bonta telephone. For Mr. Barney has *himself* an instrument which also *professes* to work on the pulsatory system. I am afraid Mr. Barney's claim for glass as a diaphragm was a very old claim before his.

**J. S. Ross.**

*October 5th*, 1887.

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### Telephonic Litigation in the States.

The readers of the ELECTRICAL REVIEW and the British public also are not ignorant that in November, 1885, the Attorney-General of the United States applied to the Secretary of the Interior, under whose jurisdiction is the Patent Office, for information respecting any fraud committed by Prof. Bell, or his patent attorneys, by means of which the patent was fraudulently issued to Prof. Bell.

The secretary decided to investigate all the proceedings in the Patent Office touching the application for the patent by Prof. Bell, and he decided to hear evidence from certain persons who had made the allegations, and from the Bell Company.

In this investigation the secretary was assisted by the first and second assistant secretaries. Numerous hearings were had, and on January 14th, 1886, the secretary gave a long written opinion.

The principal question before him was: "Has the Government the right to institute a suit to annul a patent for fraud?"

The Commissioner decided that there was enough evidence of fraud shown upon the hearing before him to require the submission of the matter to the court at the instance of the Government.

Acting on this opinion of the Commissioner, the Attorney-General brought a suit in the U. S. Court in Ohio. The Bell Company demurred to the jurisdiction of the court, on the ground that the Bell Company had no residence in Ohio, but that it was a corporation created by the State of Massachusetts, and its legal residence was in Massachusetts. The court, after long deliberation, dismissed the suit.

The Attorney-General thereafter brought suit in Massachusetts.

The Bell Company demurred to the suit on the ground that, in the absence of any statute authorising the U. S. Government to bring a suit to annul a patent, the Government had no right to institute such a suit. The court sustained the demurrer and dismissed the suit last week.

This decision is not final, and I hear that the case will be appealed to the U. S. Supreme Court forthwith.

I have not been able to find but three instances in which a suit to annul a patent has been instituted, and the decisions of the U. S. Circuit Courts in those cases are at variance. One such case was tried in the U. S. Circuit Court in Rhode Island, and that court denied that the power existed in the U. S. Government, in the absence of a statute conferring such power.

The United States Circuit Court in New York, in two recent cases, affirmed the existence of such a power.

The most important case was that in the New York Circuit Court of the U. S. Government against one John Gunning, to annul his patent on the ground that it was obtained by fraud. The defendant's counsel demurred to the bill in equity, on the ground that there was no authority in law for the bringing of suits of this character in the name of the U. S.

The Circuit Judge Wallace over-ruled the demurrer—the defendants made answer, and the case then came up upon its merits before Judge Wheeler, who rendered "a decision that the letters patent had been procured

by misrepresentation, and should be surrendered and annulled."

The Gunning case was identical with the suit against the Bell patent, and the decision rested "entirely upon the ground that the Government is bound to interfere and protect the public from vexatious and expensive litigation, occasioned by a franchise fraudulently obtained."

The Supreme Court has never decided this point directly, for the simple reason that it has never been brought before it. But it has expressed the opinion, an *obiter dictum*, as the lawyers say, that the suit may be brought.

My investigation leads me to express my opinion that the U. S. Government has a right to institute such a suit, and my investigations of the brief filed by the U. S. Attorney-General against the Bell patent, and of the evidence upon which the Government rely, lead me to express a very strong belief that there was no fraud committed by Bell or his patent attorneys, and that a trial on the merits will result in establishing the absence of fraud, and consequently the patent will be sustained.

The decision in the case which was argued last January before the U. S. Supreme Court, is expected to be rendered when that court meets in October. In that case five parties appealed from as many decisions of U. S. Circuits Courts, which decided that Bell's patent was valid, and that all the defendants had infringed his patent, specially Bell's fifth claim in his patent of March 7th, 1876, wherein he claims the exclusive right to use an undulatory current for the transmission of articulate speech.

I attended daily that case, and from the arguments of counsel on both sides, and from the evidence filed in the lower courts, I do not hesitate to express my strong belief that the fifth claim will be sustained, because no evidence was produced in any of the cases that such a current had been previously used, or stated to be used, for the transmission of articulate speech. As to the claim of Bell to be the inventor of the speaking telephone, I cannot think that it will be allowed, for the simple reason that it has been proved, many times and oft, that the Reis instrument, made as described by him, did and does transmit articulate speech. But I admit that it does not do so in a manner sufficiently well for practical purposes. Bell's invention is simply an improvement on that of Reis; but I do not hesitate to assert that Bell's receiver is constructed on precisely the same principles and in the same manner as that of Bourseul, described in a newspaper published in 1856. There cannot be any doubt that Bell took the idea of his iron tympan from the description of Bourseul's instrument in a book entitled "Wonders of Electricity," by J. Beille, published in Boston in 1873, where Bell resided at the time he says he was investigating this subject.

Should, however, the fifth claim of Bell be annulled, it will not seriously affect the Bell Telephone Company, because that company owns Edison's and Berliner's carbon patents, by which alone articulate speech has been heretofore successfully transmitted. It seems, then, that here, as in Great Britain, the Edison patents will control telephoning until 1894, the date of the expiration of his patents of July 20th, 1877, unless an instrument can be constructed for transmitting articulate speech by means of makes and breaks between metallic contacts.

**W. C. Barney.**

New York, *September 30th*, 1887.

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### On Copper Wire.

IN the issue of September 16th I read a report of Mr. Preece's paper "On Copper Wire," presented at the recent meeting of the British Association for the Advancement of Science.

This paper and its discussions interested me because I have made a great many tests upon samples of hard-drawn copper wire manufactured for the American Bell Telephone Company, and have inspected more than 100 tons of the wire used by them in the telephone service between New York and Philadelphia. Mr. Preece has good reason for recommending the extended use of copper wire, and the advantage of its small retardation is much more manifest in telephonic than in telegraphic work.

But I differ from Mr. Preece in calculating the effect of change of temperature upon the sag and stress of a span of wire. General Webber's question in the discussion as to the strain at which copper wire begins to stretch, should have led to the discovery of the fallacy in Mr. Preece's calculation. His method is identical with that given in Munro and Jamieson's "Pocket-book of Electrical Rules and Tables," page 247 (second edition), and, so far as I am aware, has hitherto been undisputed. This method treats of wire as if it were inelastic, *i.e.*, it makes no allowance for the stretch due to increased strain.

The fallacy can best be exposed by starting from the point opposite that taken by Mr. Preece. Suppose a span of wire to be stretched taut in warm weather, what will be the effect of the cold of winter? Taking the same maximum difference of temperature, viz., 30° Centigrade, the contraction of copper *not* under tension is ·0005, or $\frac{1}{20}$th of one per cent. In a span of 100 yards this becomes 1·8 inches—greater than the excess of the length of wire over the span, unless, indeed, the dip exceeds four feet. Should the wire of a span under tension contract by this amount, it would not reach from one support to the next. Hence the wire *must* break. But in an experience covering two years with the copper telephone line between Boston and New York, built mostly in the autumn, I have never known any breakage of the lines to be attributed to the cold weather. Indeed, when I put the question to one of the linemen, he said that breaks occurred very seldom, and the few that he had met with were all accounted for by some evident cause, like the falling of a tree upon the line.

Since the wire does not break as this theory indicates, the theory must err. The *fact* is easily explained. An elongation of $\frac{1}{20}$th of one per cent., my experiments upon 5 feet specimens of hard-drawn copper wire show to be equivalent to a strain of only 7,500 lbs. per square inch, a strain well within the elastic limit of copper wire.

The contraction due to a fall in temperature of 30° Centigrade would then be exactly counterbalanced by an increased strain of only 7,500 lbs. per square inch. There is in reality a combination of these two elements; the contraction due to temperature tends to shorten the wire, giving increased tension, which tends to elongate it. The result is a comparatively trifling difference in the sag between summer and winter. By a succession of approximations some months ago, I derived the following table not verified by actual measurement, but which I believe to be substantially correct. The fall in temperature of 60° Centigrade represents the extreme difference between the hottest summer and the coldest winter day of our variable climate.

*Table showing sag and stress upon a span of No.* 12 *hard-drawn copper wire.*

| | | Span 50 yds. | | Span 60 yds. | |
|---|---|---|---|---|---|
| At any temperature | stress on support, lbs. | 100 | 200 | 100 | 200 |
| | corresponding sag, in. | 12 | 6 | 17 | 8·5 |
| After a fall of 60° Centigrade ... | stress would be, lbs. | 220 | 325 | 210 | 320 |
| | corresponding sag, in. | 5·3 | 3·6 | 8·1 | 5·3 |

Observation has proved that the difference in sag between summer and winter is not so great as that given by Mr. Preece's calculations.

A formula to cover the case in discussion would contain two variables, but would not of necessity be especially formidable. Since the American method of wire running, in which the lineman exerts his whole strength upon the wire whether the day be hot or cold, has proved entirely satisfactory in practice, I leave the

mathematical solution of this interesting but unprofitable problem to some one who has time to spare for such work.

**Morgan Brooks.**

Boston, U.S.A., *September 30th*, 1887.

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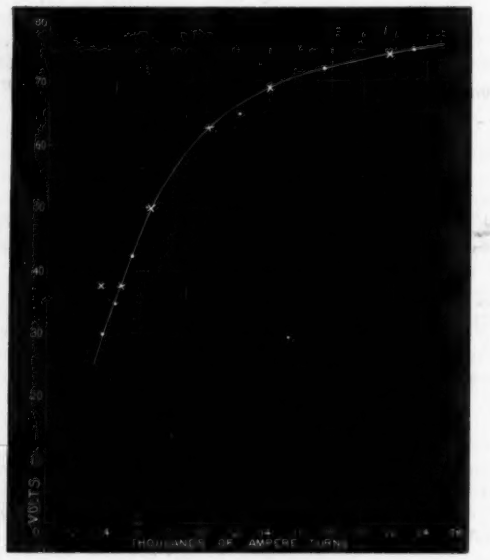
### Magnetic Permeability of Iron.

In reply to Prof. Ewing's question, the estimate of 8 inches of iron as offering equivalent resistance to that of a joint, is based upon the resistance which has been found necessary to make observed experiments agree with the predicted calculations of various dynamos; it does not pretend to any great accuracy, but merely gives an idea of the allowance which is made in practice. I may add that more recent experience suggests that 8 inches is too great.

It should be observed that the areas of dynamo magnets are from one to two thousand times that of Prof. Ewing's experimental bar, and in order to obliterate the resistance of the joints in a dynamo having a magnet area of 160 square inches, a couple of bolts $6\frac{1}{4}$ inches diameter would be required, and they must be tightened up to give a pressure of 22 tons.




The accompanying diagram shows by the crosses, a magnetisation curve calculated from a drawing by Mr. Ravensbaw, and the circles show the actual observations of tests with the machine when built. The cross at 38 volts, a little to the left of the curve, shows the result obtained by calculation by *omitting* the value of the resistance of the joint. I am not aware that a curve showing so close an accordance of calculation with actual observation, in dynamo building, has yet been published. The method of calculation is merely a modification of that suggested by Messrs. Kapp, Forbes, and Hopkinson, the data being taken entirely *from a drawing*.

In no branch of engineering, as far as I am aware, do the predictions of the drawing office agree more closely with the observations of the testing room than in this example, which was taken at random.

**A. P. Trotter.**

*October 5th*, 1887.

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### British Association Notes.

In my sketch of electrical papers read at Section A (see REVIEW, September 23rd) there were one or two slips which you will allow me to correct.

The mercury standards which Mr. Glazebrook had found to vary were not those of M. Mascart, but were made by Strecker and Himstedt; see his paper in the October number of the *Philosophical Magazine*. Mr. Glazebrook tells me that Mascart's standards agree consistently with his own.

All mention of Mr. Preece's paper on "The coefficient of self-induction in telegraph wires" was inadvertently omitted. This, and one or two other communications which I failed to hear read, will shortly appear, or have already appeared, in full in these columns.

Sir William Thomson publishes his paper "On the vortex theory of the lumiferous ether" in the October number of the *Philosophical Magazine* under the title "On propagation of laminar motion through a turbulently moving inviscid liquid," and an abstract in *Nature* for October 6th, page 550.

It there appears that the subject has occupied his thoughts at intervals for the last 20 years, and that I must have been wrong in judging from his manner at Manchester that it had been to him a fairly easy problem only lately attacked. This is a personal matter of no concern to anybody except, perhaps, a future biographer; all that I wish to call attention to is the official publication of the discovery, so far as it is as yet made, by the author. The one definite point in the proof, still incomplete, is that a dissipation of wave-energy by rearrangement of the vortices has not yet been shown to be impossible, or, if possible, so slow as to be negligible. In other words, an assemblage of vortex filaments has been proved capable of transmitting waves of distortion like an elastic solid, but it has not yet been proved to be thoroughly *transparent*. It is hardly likely that the ether itself is absolutely transparent, else would the midnight sky be one blaze from an infinitude of stars foreshortened together. Either the universe of worlds is limited, or the ether has a trace of opacity. The latter is the more probable hypothesis; and, accordingly, the amount of transparency possessed by an assemblage of vortices of any required degree of smallness has still to be worked out. Let us hope that by the time the British Association meets in Bath the illustrious author will have this step also ready to communicate.

**Oliver J. Lodge.**

University College, Liverpool,
*9th October*, 1887.

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### Secondary Batteries.

I reply to Mr. Epstein's letter of September 9th with great reluctance because I sympathise with him, knowing how hard he worked for several years, with a view of improving or inventing secondary batteries. I remember well how earnestly Mr. Epstein strove to construct plates according to a method mentioned in his mysterious patent of 1884, and, failing with that, he made grids precisely like those of the Electrical Power Storage Company, samples of which he gave me nearly two years ago. Unfortunately, or fortunately, these plates of Mr. Epstein were not as good as the E.P.S.; if he has since succeeded in producing a first-rate storage battery without copying others' work I congratulate him most heartily.

**A. Reckenzaun.**

Philadelphia, U.S.A., *September 27th*, 1887.

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### Humming of Telephone Wires.

In your number of October 7th, you notice that Mr. John Shakspear has written to the *Times* an account of a discovery he has made for stopping the noise occasioned by overhead wires. His remedy is India-rubber tubing loosely fitted on the wire.

This device was suggested to me in March, 1884, by Serjeant-Major Buck, R.E., who was at that time inspector of a postal telegraph district. It was then used with perfect success, and has been similarly made use of on many subsequent occasions in the southern district of the Postal Telegraphs.

**Chas. F. C. Beresford,** *Major R.E.*

*October 10th*, 1887.